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ESSENTIALS

OF

DISEASES OF THE EYE

BY

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PREFACE.

For several years a demand has been made upon the author for a condensed work upon the eye which should exclude all theories, technical terms and phrases and which should give as concisely as possible the essential features of eye diseases together with their homœopathic treatment.

In this little manual the aim has been to so simplify the study of eye diseases that the student and general practitioner may gain in a short time a practical knowledge of, at least, the more common diseases of the eye.

The effort to cover the fundamental facts of ophthalmology and to say enough and not too much has been constantly kept in mind.

Infrequent conditions and those of interest chiefly to specialists have been but briefly mentioned. The common diseases that general practitioners are called upon to treat have been given with sufficient fulness to supply a practical working manual.

In a work of this size it would be impossible to give the homœopathic treatment in detail; the remedies given are those the author has found most frequently of service and the indications given are the characteristics, and in most instances verified symptoms which can be relied upon.

In an experience of nearly twenty-five years the author has seen many an eye lost that should have been saved by correct treatment at the beginning. Observation has demonstrated that the general practitioner as well as the student look upon the eye as an exclusive specialty to be avoided rather than investigated. The result of this attitude has been detrimental to the best interests of the physician and too frequently calamitous to the patient.

It is hoped that this little book will contribute to a greater interest and a better understanding of these diseases.

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CHAPTER I.

EXAMINATION OF THE EYE.

The importance of a thorough and systematic examination, not only of the eye itself, but of co-existent general conditions, in order to determine the underlying states and to make a correct diagnosis, cannot be overestimated. Every patient should be examined systematically for both an accurate understanding of the case and for the preservation of careful records for subsequent use.

In the examination of the eye itself, we cannot emphasize too strongly the value of systematic methods. Many times has the ophthalmoscope revealed a retinitis or an optic neuritis in cases with a normal acuteness of vision, and no symptoms indicative of an intra-ocular disease. Therefore, we would urge, the thorough examination and the full recording of all eye cases. The author's method is in every instance to first determine the visual acuteness and any refractive error that may be present, the range and power of the accommodation, and the strength and balance of the extra-ocular muscles. The appearance of the lids, lachrymal sac, conjunctiva, sclera, cornea, iris, aqueous humor and lens are carefully noted; following this, a thorough ophthalmoscopic examination of the entire fundus should be made. The examination as to the field of vision and color-perception is not necessary except in more rare instances.

EXAMINATION OF THE OUTER STRUCTURES.—Much can often be learned by noting the general appearance of the patient and of the eyes. We can detect from a casual glance as the patient enters the room the presence or absence of photophobia, lachrymation and discharge from the eye—the character of the discharge, if purulent or mucous, thick or thin, bland or excoriating. A paralysis of the muscles can often be recognized by the inclination of the head, and the deviation of the eye will denote either a paralysis or strabismus. Twitchings of the lids, the face or other parts of the body will indicate nervous disorders. The expression of the face and the general physical condition are also to be noted.

The lids first attract our attention when we come to examine the eye proper. If swollen—whether hard and tense, or soft and œdematous—their mobility and position; their edges for distorted cilia, the presence of parasites or inflammation; their inner surface for granulations, cicatrices, secretions and foreign bodies.

To examine the inner surface of the upper lid and the superior cul-de-sac, which, as a rule, gives more characteristic indications than does the lower, and to remove foreign bodies it is necessary to evert the upper lid. The eyelashes of the upper lid are seized by the index finger and thumb of the left hand, the lid is then drawn downward and away from the ball, the point of the thumb of the right hand or pencil is then placed above the tarsal cartilage of the lid and by a quick downward pressure of the thumb and a simultaneous upward movement of the left hand grasping the cilia the edge of the lid is turned over the point of the thumb. During the entire manœuvre you must insist upon the patient's keeping the eye downward, if not the eversion of the lid becomes unnecessarily difficult and painful. When everted the thumb of the right hand presses the edge of the lid backward against the eyeball and holds it for examination.

The Lachrymal Puncta and Sac should be examined for any obstruction, and by pressure over the sac notice whether any mucoid material or tears can be expressed from the puncta.

The Conjunctiva.—The inspection of the conjunctiva shows us the presence of phlyctenules, pterygium, growths, adhesions, etc. Note if the redness is due to the large, tortuous, bright red superficial vessels of the conjunctiva, which are especially numerous toward the periphery and looser portion of the membrane, or if fine, radiating lines, pink in color, confined to the ciliary region and due to the episcleral vessels. In some cases we may note a leash of vessels, more or less pyramidal in shape, with the apex toward the cornea, indicative of an ulceration. Again, we may see a marked enlargement and tortuosity of the episcleral veins, suggesting a glaucoma.

The thorough examination of the conjunctiva and cornea in young children where there is much photophobia and inflammation is usually a matter of great difficulty. When, owing to these causes, there is a spasmodic contraction of the lids, their forcible separation is best accomplished as follows: The nurse or attendant seated at your side lays the child across her lap with the head held firmly between the surgeon's knees. The attendant in this way can readily hold the child's hands, feet and body while the head is held as within a vise by the surgeon's knees. The surgeon then grasps the ciliary border of the upper lid with the index finger of the right hand and with the thumb of the left hand the border of the lower lid. In opening the eye the pressure must be mainly upward toward the supra-orbital ridge and just sufficiently backward to prevent the eversion of the lid. Great care must be used *not* to make too great pressure backward or downward upon the eyeball, because in an ulceration of the cornea (which is so apt to be present in cases where this method has to be resorted to) the pressure is liable to cause a rupture of the cornea with loss of the eye. You will often have to hold the eye open for several minutes before a clear view of the cornea can be had.

The Cornea.—As the examination of the cornea is greatly facilitated by the use of the oblique illumination, it should always be employed. Make it, therefore, a routine practice in all cases when examining the anterior part of the eye. Its use aids the minute examination of the lids and the conjunctiva, as well as the cornea, iris, lens and aqueous. By it we may often determine small superficial ulcers and abrasions, commencing interstitial infiltrations, faint opacities or nebulæ, and particles of foreign substances imbedded in the cornea.

Oblique Illumination or, as it is sometimes called, *focal* or *lateral illumination*, should be made by placing the patient two feet from the gaslight in a darkened room, as preferable to daylight, the light is then brought to a focus upon the cornea with a two or three inch lens, the surgeon may at the same time if necessary observe the surface under examination through another magnifying lens held before the eye.

The Iris.—Inspection of the iris may frequently reveal normal physiological differences in color or shade of the two irides; and we may also have instead of the uniform pigmentation one or more irregular spots of different color. We can also detect by the oblique illumination swelling, discolorations and vascularity of the iris tissue; the loss of lustre or the presence of gumma, foreign bodies, etc.; the shape and size of the pupil, the presence of adhesions to either the cornea or lens. The mobility of the iris should be carefully studied, as the pupils of the two eyes should act consensually; to examine, the patient is placed before a window in daylight and directed to look at a distance; one eye is then covered, the other, exposed eye, will contract to the bright light, while the covered eye acts in harmony. If both eyes be now shaded dilatation ensues, and then again exposed to the light, contraction immediately follows, succeeded in a moment by slight dilatation and again a contraction; thus oscillating for a moment it finally settles down to its original size. As the pupils contract under the influences of accommodation and convergence, care must be taken during the examination that the eyes are constantly fixed on a distant object.

Dilatation of the pupil occurs in glaucoma, atrophy of the optic nerve, from fright, in anæmia, nervous conditions, etc., in young people and from the use of mydriatics.

Contraction of the pupil occurs in old people, from the use of myotics, is present in inflammation of the iris, in some fevers, in mitral disease and pulmonary congestion, and in paralysis of the sympathetic.

Anterior Chamber and Lens.—The examination of the anterior chamber and lens also, by the aid of the oblique illumination, shows if the former is more shallow or deeper than normal, the presence of any exudation, etc., while in the lens the faintest trace of disturbance or change can be detected.

Proptosis or protrusion of the eye, if unilateral, may be noted by comparing the position of the corneæ with each other and with the brows. It is present in Graves's disease, orbital diseases, intra-ocular tumors, paralysis of the ocular muscles, etc.

Tension.—Finally the tension of the eye should be noted. To estimate the tension of the eyeballs the patient should be made to look downward and to gently close the eyes, for, if squeezed tightly together, that alone may slightly increase the tension. The index fingers of both hands should be applied to the lids and press gently first with one finger and then the other. The tension should always be estimated from palpation of the sclera some distance back of the cornea. Estimate according to the resistance or indentation of the globe. The following signs are used for designating the degree of the tension, viz.: Tn, tension normal; T + ? or T — ?, a doubtful increase or decrease of tension; T + 1, a marked increase as compared with normal; T + 2, a greater increase, but the globe admits of some dimpling; T + 3, stony hardness, or no impression from firm pressure; T — 1, a decrease as compared with normal; T — 2, greater loss of tension, and T — 3, eye very soft, no tension at all. The tension differs physiologically in different eyes; the sclera is more elastic in young than in old people; a large eye yields more than a small one, and variations in the form of the eye affect the tension. Diseases of the sclera might increase or decrease the tension. Variations in the curvature of the sclera at the point of impression will cause a slight difference in the tension, the greater the curvature the softer the eye. The tension of one eye should always be compared with its fellow, and when in doubt with an eye known to be normal, in a person of the same age as the patient.

The Field of Vision.—By the field of vision is meant the space, when the visual axis of one eye is fixed upon some stationary point, in which all other objects are visible. This space is large or small, in proportion to the distance at which the fixation point is from the eye. The object fixed imprints its image upon the macula lutea, while the images of all other objects fall upon some peripheral portion of the retina.

Peripheral vision is of value, in that while we only see objects indistinctly upon which the visual axis is not fixed, it attracts our attention to other objects which we may desire to see, and the eye is then turned in that direction. As, for example, in crossing a street our peripheral vision is attracted by the approach of a team within the field of vision and our attention is turned to it that we may avoid an accident. In many diseased conditions of the fundus a knowledge of the field of vision is of the greatest importance both in diagnosis and prognosis.

The normal field of vision varies in different directions, being greatest toward the temporal side, where it has an extent of over 90°. The field at the nasal side and above is of much less extent, because of the limitation caused by the nose and brow. The normal field for colors is found practically to be more contracted than that for white, and to vary with the different colors—blue being the least contracted, red next and green the most contracted.

Pathological changes in the field of vision are both numerous, varied, and, in many diseases, are quite characteristic. Alterations in the visual field may be concentric, uniformly drawn in at all points; sector-shaped, where it has the shape of a triangle whose base corresponds to the periphery; or, hemiopic, one-half of the field wanting. In addition to these more or less regular and frequently found forms of contraction there are many irregular shaped notches in the normal field. *Scotomata*, or blind spots in the visual field, when found as the result of disease, are classed as central or peripheral. In the healthy eye we have a scotoma, known as Mariotte's blind spot, which corresponds to the entrance of the optic nerve and lies about 15° to the outside of the point of fixation.

Concentric contraction with central vision impaired, may be found in atrophy of the optic nerve or retina; with central vision good, in retinitis pigmentosa and sometimes in the early stages of glaucoma. *Sector-shaped* alterations may be found in atrophy of the optic nerve, in occlusion of one of the retinal arteries, in detachment of the retina; in glaucoma the nasal side is contracted. *Scotomata* are found in choroiditis disseminata and other choroidal diseases, in hemorrhages, especially when in the macula lutea, in toxic amblyopias, etc.

The importance of a careful study of the field for colors, as well as for white, is well illustrated in atrophy of the optic nerve, as in this disease the color field is more constantly involved than that for white, and in some cases will be the first sign of the disease. In glaucoma the field for colors is lost with that for white, and they bear the same concentric arrangement throughout. In toxic amblyopia there is frequently found a central scotoma for red and green.

Examination of the Field of Vision.—This must be made for each eye separately; the eye to be examined is directed at a fixed point, as it must remain steadily in the same position, while the other eye is closed. There are three methods of determining the field of vision ; the simplest, and, at the same time the poorest, is that by using the hand as a test-object. The physician stands in front of the patient, who directs his left eye to the right eye of the physician, the other eye of each being closed. The physician then moves his hand in a plane midway between the patient and himself from the periphery inward over the limits of the field of view. The patient is to tell as soon as he sees the hand, and if his field is normal he should see the hand at the same time as does the physician. This method is only adopted to determine large defects and in those where the central vision is too poor to see smaller test objects.

The *blackboard* is the second method of determining the field. In this the patient's head is rested on a support 30 cm. from the board. A chalk mark is made directly opposite the eye to be examined, on which he is to fix his gaze. The chalk is now gradually approached from the edge to the center, and the patient tells at the moment he first sees it. By marking the spot where he first sees the chalk in all directions of the field, and then connecting the points thus determined, we have the field of vision. By using colored chalks we can determine the field for the various colors. This method is also inexact.

The only exact and scientific method of determining the field of vision is that with the *perimeter*. The patient's head is supported on a chin rest, which is so placed in front of a semi-circle that the eye to be examined is situated in the centre of the curvature of the latter. The eye is then fixed upon the middle point of the semi-circular arc, while a test-object, a small white or colored square, is carried along the arm of the semi-circle. The semi-circular arc is marked with a scale of degrees which can be read off, or in the best perimeters is self-registering on a chart attached.

CHAPTER II.

THE USE OF THE OPHTHALMOSCOPE.

In all the realm of modern medicine there has probably been no one discovery of greater beneficence to humanity than the invention of the ophthalmoscope by Helmholtz in 1851. Through its use the mysteries of the interior of the eye stand revealed and many conditions that previously resulted in blindness are now made remediable. With it we are able to study changes in the circulatory system, as exhibited in the retinal vessels; and in the optic nerve and retina we have, under the eye of the surgeon, direct communication with the brain and spinal system. The ophthalmoscope, therefore, has become of the greatest value in general medicine as an aid to diagnosis, for in the fundus of the eye are found many characteristic changes of disease of the various organs. Helmholtz's discovery was not a matter of chance, but resulted from a careful study of the laws of optics, one of which is that light follows the same lines in returning through a lens (in case it can return) as when entering. The rays of light returning from the eye must go direct to the luminous source from which they emanated, and in order to fall upon the retina of the observer his eye must be in the path formed by the source of the illumination and the eye under examination. The device used by Helmholtz consisted of a transparent mirror formed of three slips of plane glass. The present principle of a perforated metallic mirror was first proposed by Ruete, in

1852. The modern ophthalmoscope consists then of a concave mirror, silvered on the back, for illuminating the eye and a series of lenses for measuring the refraction, and for diagnosing pathological changes by the direct method.

The Art of Using the Ophthalmoscope is one much more difficult to acquire than that of any other instrument of precision and is only accomplished after long and persistent practice.

The first and most essential point in order to become a skilled ophthalmoscopist, and which is often neglected, is familiarity with the healthy fundus. The student should first practice over and over again upon every healthy eye-ground he can before attempting to study diseased states. This necessity becomes apparent from the fact that the normal fundus in health varies with the age, condition and complexion.

In making an ophthalmoscopic examination artificial light is preferable to daylight. We therefore darken the room and use a single light, the best being that from an Argand burner or a student's lamp.

There are two methods of examining the fundus of the eye: First, the *direct* method, so called because the eye-ground is studied by rays coming directly from it, and by this method we have an upright image; and second, the *indirect*, because the rays are received from an ærial image, or indirectly from the observed eye, and the image seen is inverted. The latter method will first be considered because it is more frequently employed.

The Indirect Method, or the method of examination by the *inverted image*. In this the patient is seated in a darkened room with the light from an Argand burner about eighteen inches behind, on the same side, and level with the eye to be examined. He should be instructed to fixate the unused eye upon some distant object. The observer sits about eighteen inches in front of the patient and holds the ophthalmoscope in the hand corresponding to the eye to be examined. A convex lens, about thirteen to eighteen diopters, is held between the thumb and forefinger of the unused hand before the eye of the patient. By resting the middle, third and little fingers upon the outer part of the supra-orbital ridge of the patient's eye the lens is held steadily and focused upon any part of the fundus desired, and the middle finger may also be used if necessary to raise the upper lid for a better view. In all ophthalmoscopic work the student should learn to keep both eyes open, as the effort to close one eye tires the eye and prevents the complete relaxing of the accommodation. He should also accustom himself to using the right eye and holding the ophthalmoscope in the right hand when examining the right eye of the patient, and the left eye and hand when examining the left eye. The first objective point is the optic nerve head, and when examining the right eye, this is brought into view by having the patient look at the right ear of the observer, and *vice versa*, when examining the left eye, the patient should be told to look at the left ear of the surgeon. From this point he may be told to look directly at the center of the observer's forehead, which gives a view of the macula lutea, and then, up and down, to the right and left, in order to examine all parts of the fundus. If the image of the disc when first brought into view appears dim and ill-defined, the lens and the ophthalmoscope should be moved slightly forward or backward until the image is as clear and distinct as possible. The image by the indirect method is magnified about four or five times, while by the direct method we get a picture magnified about fourteen times. The extent of the field of vision on the contrary is about four times greater in the indirect than it is by the direct method. The indirect method gives then a larger view and better general relation of the fundus, while the direct method is particularly adapted for the recognition of the finer details.

The Direct Method, or the examination with the *erect image*. The patient and light are placed in the same positions as in the indirect examination. The surgeon seats himself by the side of the patient and again uses his right eye in examining the right eye of the patient, and *vice versa*. The ophthalmoscope is held in the same hand as the eye to be examined and brought up to about one inch from the eye of the patient. Both eyes are to be kept open so as to avoid as much as possible the impulse to accommodate. As the field is enlarged, and the examination by this method greatly facilitated by a dilatation of the patient's pupil, the use of a mydriatic is to be recommended to the student when first learning to use the direct method. The dilatation of the pupil can be increased also by having the room as dark as possible, by closing the other eye, and lowering the light from which the illumination is received.

By the direct method, if both the eye of the observer and of the patient be normal in refraction, and the acommodation at rest in both, the details of the fundus are readily seen. If, however, either the surgeon or the patient be myopic, or if hypermetropic in excess of the power of accommodation to overcome, the refractive error must first be corrected. The power of relaxing one's accommodation comes by practice. The primary objective point in the examination is, as by the indirect method, the optic disc, and this is brought into view by having the patient look straight forward while the surgeon looks into the eye slightly from the temporal side.

The Fundus of the Eye as Seen by the Ophthalmoscope.—As already mentioned, the first objective point in all examinations of the interior of the eyeball is the *optic disc*, or *papilla.* The optic nerve appears usually as a circular or slightly oval shaped disc, but may be quite irregular in outline. Its color varies from a pinkish white to a deep red, and may vary in different parts of the disc, usually paler at the center than at the circumference, or the nasal side a more decided red than the temporal. The tint also varies with the age and complexion of the patient, and the contrast with the color of the surrounding fundus. The white spot, seen usually at the center of the disc, or, rarely, more at the temporal side, is called the physiological cup or excavation. Care must always be taken to differentiate this physiological cupping from the excavation found in glaucoma and in optic nerve atrophy. A description of the different forms of cupping of the disc will be found under the study of glaucoma. The border of the optic disc is well defined, being sharply outlined by a double ring.

The next most noticeable features are the blood-vessels. The arterial trunk usually divides, just before emanating from the bottom of the disc, into an upward and downward branch, each of these branches generally dividing again as they pass off from the optic disc. These arteries as they spread out above and below continue to divide dichotomously into numerous branches, supplying all parts of the fundus, excepting a small area at the temporal side of the optic nerve. This area is called the *macula lutea*, or yellow spot, and at its centre is the point of most distinct vision, the *fovea centralis*. The temporal half of the retina is more freely supplied with blood-vessels than is the nasal side. The retinal veins follow the same general course and parallel to the arteries, and empty by two large branches into the centre of the disc. The arteries and veins are distinguishable by their size and color, the veins being larger in proportion of about three to two and of a dark red as contrasted with the bright color of the arteries. The veins are also more tortuous in their course and spontaneous pulsation is not infrequently seen in the veins. The so-called *reflex* or *light streak*, which runs along the crest of the vessels, covering about one-third of their diameter, is of a pale straw color, and is more brilliant, broader and more sharply defined upon the arteries than veins and may be entirely absent in the veins.

The appearance of the *macula lutea* is as difficult to describe as it is to the student to see. In many cases when we examine the macular region we see nothing, and often we are but conscious of a luminous oval ring, the centre of which is marked by a small spot of a dark color. This phantom-like reflex, or, as it is sometimes called, halo, varies in size, though usually of an oval or circular shape. The inclosed space seems to be more of a grayish or brown color than the yellow we should naturally expect from the macula lutea being commonly spoken of as the yellow spot. The location of the yellow spot is about one and one-half optic nerve diameters to the outer side of the disc and is usually best seen by the indirect method.

The *retina*, being a transparent membrane, is practically invisible and reveals nothing of its delicate structure excepting the retinal vessels, which are readily seen ramifying within its inner layers. To the observer, especially when inexperienced, the retinal vessels seem to course over and form a part of the background of the eye. They should, however, always remember that they lie some little distance in front of the underlying choroid. Recognition of the *choroid* varies with the pigmentation of the eye. The bright red color from the pupil when the eye is illuminated with the ophthalmoscopic mirror arises from the choroid. The choroidal vessels appear as flat curvilinear stripes of a light pink hue interlacing in distinct meshes. The pigment stroma shows as irregular patches within the meshes of the choroidal vessels. The pigmentation is often more dense around the optic nerve and posterior part of the fundus. The visible choroidal vessels are always broader than the retinal trunks, and no distinction can be made between the arteries and veins.

CHAPTER III.

REFRACTION AND ACCOMMODATION OF THE EYE.

NORMAL REFRACTION AND ACCOMMODATION.—The dioptric media of a normal or emmetropic eye (cornea, aqueous humor, lens and vitreous humor) have the requisite refractive power to bring parallel rays of light to a focus on the layer of rods and cones of the retina. These media are centered on the optic axis, the line passing through the centre of the cornea and the posterior pole of the eye.

Upon the optic axis are situated the *cardinal points* of the dioptric system.

Objects situated at a distance of five metres or more are considered as being at infinity, because rays from such objects enter the eye so slightly divergent that for practical purposes they may be considered parallel. As parallel rays are brought to a focus at the second principal focus, the eye is capable of forming distinct inverted images of distant objects upon the retina.

The eye, however, can also see near objects distinctly, and as the rays from such sources become more divergent the nearer they approach, it is obvious that it must contain some mechanism to increase its refractive power. The power by which it is increased so that divergent rays are also brought to a focus on the retina is the accommodation.

Static refraction. By this term is meant the power the eye has when at rest (without an effort of accommodation) to bring the parallel rays of light to a focus on the retina or to render divergent rays less divergent.

Dynamic refraction constitutes the increase of refractive power produced by the effort of accommodation.

The mechanism of accommodation is as follows: By contracting the ciliary muscle the tension on the zonula of Zinn is relaxed, permitting the anterior surface of the lens to advance and become more convex through its own elasticity, and thus increasing the refractive power.

The Far and Near Points.—The name *punctum remotum*, or far point, is given to the point to which the eye is adapted when at rest. It represents the most distant point of distinct vision, and is designated by R. By the term *punctum proximum*, or near point, is understood the nearest point of distinct vision. It is found by ascertaining the nearest point at which the smallest test-letters can be read, and is designated by P. It is possible for the eye to see all objects distinctly between these two points.

The range, or amplitude, of accommodation is the amount of accommodative effort of which an eye is capable, and is equal to the difference in the refractive power when in a state of rest and when its accommodation is exerted to the utmost.

Convergence.—Ordinarily man looks simultaneously with both eyes, yet appreciates but a single image. This union in one single impression of the retinal images received by both eyes is called binocular vision. In order to obtain this, each eye must receive upon its fovea centralis a distinct image of the object, and hence it is necessary that both lines of fixation be directed towards the object looked at. When looking at a distant object the lines of fixation are parallel, but the nearer it approaches the more the lines of fixation must converge and the eyes turn in. The degree of convergence is measured by the angle through which an eye turns when it fixes the object.

Accommodation and Convergence Associated.—With every degree of convergence is associated a certain effort of the accommodation. That is, the refraction and convergence must increase by an equal quantity, which is the inverse of the distance of the object.

This association between accommodation and convergence, however, is not absolute, for with the lines of fixation fixed on a given point and stationary, the accommodation can be somewhat increased and diminished; and conversely, with a given amount of accommodation, the degree of convergence can be augmented and reduced.

The *relative amplitude of accommodation* is obtained by holding an object at one metre and first weak convex and then weak concave glasses are placed before the eyes while the distinctness of the image is unaltered. The part represented by the strongest convex glass which can be placed before the eye without affecting the distinctness of the object is termed the negative, and the part represented by the strongest concave glass the positive. When sustained efforts of the accommodation are necessary at any distance, it is essential that the positive relative amplitude of accommodation be considerable.

The Relative Amplitude of Convergence.—That the convergence may be altered while the same effort of accommodation is maintained can be demonstrated by placing a weak prism with its base in before one eye.

If the convergence remained unaltered, the prism would cause double vision, but the eyes rotate outward and the object looked at is still distinct and the image single. Likewise, it will be found that a weak prism with its base out will be followed by a rotation of the eye inward with no effect on the distinctness of the image.

Cardinal Points of the Eye.—In order to understand the course of rays of light through the eye it is necessary to know the cardinal points, viz., the principal points, the nodal points and the principal foci, all situated on the optical axis.

The principal points are two points close together in the anterior chamber about 2 mm. behind the cornea. They are so situated that when an incident ray passes through the first, the corresponding emergent ray passes through the second principal point.

The nodal points are two points situated about 7 mm. behind the cornea near the posterior pole of the lens. They are the optical center of the dioptric system, and rays passing through this point are not refracted.

The first principal focus is situated on the optical axis about 14 mm. in front of the cornea and is the point at which parallel rays in the vitreous meet.

The second principal focus is between the optic disc and the macula about 23 mm. behind the cornea and is the point at which parallel rays meet after being refracted by the dioptric system of the eye.

The centre of rotation of the eyeball is in the vitreous about 10 mm. in front of the retina.

The optical axis is a line passing through the centre of the cornea, the nodal point and the second principal focus on the retina.

The visual line passes from the object looked at, through the nodal point, to the macula.

The line of fixation passes from the object looked at, to the centre of rotation, and practically corresponds to the visual line.

The angle Gamma is formed by the optical axis and the line of fixation. It varies with the refraction of the eye and is larger in hyperopia than in myopia.

The angle Alpha is the angle formed by the visual line with the major axis of the corneal ellipse.

ABNORMALITIES OF REFRACTION AND ACCOMMODATION.

EMMETROPIA.—A normal or emmetropic eye is one whose static refraction is sufficient to bring parallel rays to a focus on the retina; or, one whose retina is situated at the focus of its dioptric system. Its far point is always at infinity.

AMETROPIA.—Any departure from emmetropia is known as ametropia, of which three different forms are recognized: 1. Hypermetropia, in which the retina is situated in front of the focus of parallel rays. 2. Myopia, in which the retina is situated behind the focus of parallel rays. 3. Astigmatism, in which the refraction of the different meridians is different.

HYPERMETROPIA OR HYPEROPIA.—In hyperopia the static refraction is not sufficient to bring parallel rays to a focus on the retina. Such rays if not intercepted by the retina would come to a focus behind it. As they are intercepted by the retina they do not form there a distinct image of the object looked at but a circle of diffusion. In order to bring parallel rays to a focus on the retina, it is necessary either to place an appropriate convex lens before the eye which causes them to converge or to call the accommodation into play.

Manifest hyperopia is represented by the strongest convex glass through which distant objects can be seen most distinctly when the accommodation is not paralyzed and is divided into facultative relative and absolute.

Latent hyperopia is the hyperopia that is concealed by the accommodation and is only discovered after the use of a cycloplegic.

Total hyperopia is the sum of the manifest and latent, or the entire amount of hyperopia detected after accommodation has been paralyzed.

Facultative hyperopia may be overcome by using the accommodation without squinting.

Relative hyperopia represents a greater degree, and can only be overcome by the accommodation on squinting inward.

Absolute hyperopia is the highest degree and cannot be overcome by using the entire accommodation.

Causes.—The eyeball is either abnormally short, constituting *axial hyperopia*, or its refractive power may be deficient, *curvature hyperopia*. Hyperopia is nearly always congenital. Most children are so at birth, but as they grow older the refraction increases and they become less hyperopic, or emmetropic, or myopic. Senile changes in the lens, flattening, give rise to it; and its removal, as for cataract, produces a high degree.

Symptoms.—The constant effort of the accommodation necessary in order to see distinctly gives rise to many symptoms. As the ciliary muscle tires, the vision blurs, and it is necessary to stop work and rub the eyes. Such people often seek a good light because the contraction of the pupil renders the vision clearer. Frequently too they hold the object near the face to secure larger retinal images and contract the lids to shut off the more divergent rays.

When left uncorrected, hyperopia frequently gives rise to conjunctivitis, blepharitis, nictitation of the lids, and congestion of the retina, choroid and optic nerve. Headaches and various reflex neuroses are very common.

Hyperopia is often complicated with spasm of the ciliary muscle, the effect of which is to bring nearly or wholly the entire accommodation into play. This reduces the amount of manifest hyperopia when it is of high degree, and in some instances may even convert the case into one of false myopia. The vision in the latter instance will be improved by concave glasses, though it would be a serious error to prescribe them. Such a mistake is prevented by detecting the real nature of the refractive error by means of the ophthalmoscope, as described in the chapter on dioptometry.

When spasm of the accommodation is present; it is imperative that a cycloplegic be instilled to temporarily paralyze the ciliary muscle and so suspend the accommodation.

Correction of Hyperopia.—If the patient has normal acuteness of vision and no asthenopic symptoms glasses need not be prescribed for him.

When distant vision is imperfect, and asthenopic symptoms are present, it is necessary to prescribe glasses which represent the amount of manifest trouble, either for constant use or for near work. In some instances, it may be necessary to correct the manifest and part of the latent if the latter exists. As a rule, if hyperopia is associated with exophoria it is best to prescribe as weak a convex glass as possible, whereas if esophoria is present, the strongest.

Many cases of convergent strabismus in children are cured by prescribing appropriate glasses. The degree of hyperopia can be determined by the direct examination with the ophthalmoscope or skiascopy if the child is too young to know its letters.

MYOPIA.—In this form of ametropia parallel rays of light are brought to a focus in front of the retina, therefore the latter is situated beyond the principal focus.

A myopic eye is adapted for divergent rays of light, therefore if a distant object is brought nearer it can be seen distinctly when it arrives at the far point.

In order that a myopic eye may be able to see objects at infinity, it is necessary that parallel rays be given a divergence as if they came from its far point. This can be accomplished by a concave lens whose focal distance coincides with the distance of the far point from the eye.

The divergence given to parallel rays by a weak concave glass can be overcome by an effort of the accommodation, and this is of importance in testing for myopia. It makes it essential to select the *weakest concave glass* that renders distant vision most distinct. Spasm of the accommodation is also frequently present in myopia, rendering the instillation of a cycloplegic necessary. In fact, it is generally the best plan, everything else being equal, to test myopic eyes with the accommodation paralyzed in order to prevent the very serious mistake of prescribing too strong concave glasses.

Causes.—Myopia is most frequently due to an increased length of the axis of the eyeball, *axial myopia;* but may be due to an abnormally high refractive power, *curvature myopia.* It is rarely congenital, but comes on about the eighth year and is very prone to increase.

Its progressive increase is encouraged by use of the eyes at near work, such as reading, writing, drawing, sewing, etc. Children, when reading and writing, bend their heads forward to bring them close to the books.

While myopia is more apt to come on during school life, and is more prevalent among the upper classes and in artisans whose work demands close inspection, the reverse is frequently true. All school children working under the same conditions do not become myopic, and many high degrees of myopia are found in people in the lower walks of life who do not use their eyes for close work.

In cases of commencing cataract, a weak degree of myopia often sets in as the result of the changes in the lens which cause an increase in its refractive power.

Conical cornea gives rise to myopia by the increase of the curvature of the cornea and the lengthening of the axis of the eyeball.

Symptoms.—Subjective symptoms are not as common as in hyperopia. The most common are headaches, aching of the eyeballs, burning of the lids, floating specks and congestion of the conjunctiva. Myopes ordinarily half close the lids when viewing distant objects and hold small objects quite close to the eyes.

The most pronounced objective symptoms are found when progressive myopia becomes complicated with organic disease.

Posterior staphyloma, recognized by the ophthalmoscope as a white crescentic patch at the outer side of the optic papilla, is found in nearly all myopic eyes. In extreme cases it may become annular and extend all around the optic papilla.

Often it is possible to distinguish between a stationary and a progressive myopia by the edge of the staphyloma, which, if clear cut, usually denotes it to be stationary. Conversely, if it extends towards the macula and is irregular, it is more likely to be progressive.

More serious and frequent complications of progressive myopia are choroidal degeneration and hemorrhages in the neighborhood of the yellow spot, detachment of the retina and opacities in the vitreous humor.

Divergent squint and exophoria are frequently associated with myopia.

Treatment.—On account of the ability of myopes to see fine objects so distinctly when held near to the eyes, they are popularly supposed to have strong eyes. From what has been said it is easy to appreciate what a serious mistake this is.

Owing to the progressive character of the trouble its management is a most important task, especially during the school life of children. Many cases are stationary and need cause no anxiety, but those which are progressive demand special care. In order to prevent the necessity of too great convergence, these patients should occupy themselves with large objects which need not be held so close to the eyes.

A proper position at the desk is necessary with the book on a slope and the head upright. The desk should be so placed that a good light comes over the shoulder, and it should not be too low. It is essential that the number of working hours be restricted and that frequent short rests be taken. Proper exercise in the open air is also advisable. When the more serious complications are present, complete rest of the eyes with suspension of the accommodation by atropin is to be ordered. During this time smoked glasses should be worn.

The correction by suitable glasses is an important part of the treatment of myopia.

As a general rule it is better to under-correct, especially in the higher degrees. In young subjects the amount of myopia should always be positively determined under a cycloplegic. It is then safe to give nearly the full correction in low and moderate degrees of myopia for both distance and near vision. Full correction corresponds to the weakest concave lens which gives normal vision with the accommodation paralyzed.

In high degrees of myopia some cases will stand the full correction both for distance and near vision. More often they will require for near work a weaker lens than for distance. No hard and fast rule can be given for the correction of myopia. Experience has shown that it is always best to err on the side of safety, *i. e.*, under correction.

In progressive myopia all near vision should be suspended and an under correction given for distance.

ASTIGMATISM OR ASTIGMIA.—In discussing hyperopia and myopia, the cornea has been considered as an ellipsoid of revolution, so that planes passing through it produce sections having an equal curvature, the effect of which is to bring all rays emanating from a luminous point to a single focus. But there is also a form of eye in which all the rays of light are not brought to a focus at a single point, because a refractive power is not the same in all its meridians, or in the various sections of the same meridian.

In astigmatism, those rays of light which enter in the direction of the greater curvature form their focus first and at a point nearer the dioptric system than those which enter in the direction of a meridian of less curvature. Homocentric light is therefore brought to a focus at several points instead of one.

Astigmatism is divided into *regular* and *irregular.*

In the regular astigmatism the curvature of the cornea is greater in one meridian than in another, whereas in irregular astigmatism the curvature varies in the different sectors of the same meridian.

Regular astigmatism is divided into *simple hyperopic*, *compound hyperopic*, *simple myopic*, *compound myopic* and *mixed.*

The meridians of maximum and minimum curvatures are always at right angles to each other, and most usually are the vertical and horizontal. They are known as the *principal meridians*, the vertical being generally that of the greatest curvature. The intermediate meridians between the principal meridians are of regularly intermediate refracting power.

The position of the retina with reference to the two principal foci designates the kind of astigmatism. Thus in simple hyperopic astigmatism one focus is situated upon the retina and the other behind; in compound hyperopic both are behind; in simple myopic one is situated upon the other in front; in compound myopic both are in front; in mixed one in front and the other behind.

Causes.—The seat of astigmatism is usually the cornea, but it may also be present in the lens, and when this is the case it may neutralize or augment the corneal astigmatism. Lentil astigmatism is often compensatory and is produced by localized contractions of the ciliary muscle. Astigmatism may also be produced by an oblique position of the lens. Operations upon the cornea frequently produce it by the contraction of the cicatrix formed by the healing of the incision.

Symptoms.—From what has been said it will be easy to understand the difficulties under which an astigmatic individual labors in appreciating horizontal or vertical lines, depending upon the kind of astigmatism present. As letter-press is composed for the most part of horizontal and vertical lines, and as the astigmatic eye is unable to clearly recognize at the same moment both kinds of lines in the same plane, considerable difficulty in reading letters is experienced.

Astigmatic persons often partly close their eyelids to shut out the rays from one meridian and incline their heads to one side or the other to bring the other principal meridian to correspond to the slit-like palpebral opening. For like reasons a stenoraic slit improves the vision of astigmatic individuals

Astigmatism is the cause of a very large percentage of headaches and gives rise to a number of nervous troubles of a reflex nature. Chorea and epilepsy have been cured by correcting it with proper glasses.

Frequently the weaker degrees give rise to more of these troubles than the higher, owing to the constant efforts of the ciliary muscle to overcome the error.

Treatment.—Astigmatism can only be corrected by cylindrical lenses, which are sections of cylinders parallel to their axes. Such lenses refract light in one direction only, viz., that at right angles to their axes. Thus simple hyperopic and myopic astigmatism, where one meridian is emmetropic and the other hyperopic or myopic, are corrected by convex or concave cylinders with their axes corresponding to the emmetropic meridian.

Cases of compound hyperopic and compound myopic astigmatism, where both foci are either behind or in front of the retina, are corrected by convex or concave sphericals which render one meridian emmetropic and partially correct the other, combined with convex or concave cylinders which correct the remainder.

Mixed astigmatism, where the retina is situated between the two foci, requires a combination of a convex and a concave cylinder placed at right angles to each other which set back one focus and advance the other.

As in simple myopia and hyperopia, the weakest concave and the strongest convex glasses which render distant vision most distinct represent the degree of the error. In prescribing glasses, it is the general rule to fully correct the astigmatism with cylinders, but the sphericals may be weakened to suit the accommodation. The general rules governing their selection in hyperopia and myopia apply in astigmatism. In simple hyperopic or myopic astigmatism, the strongest convex and weakest concave cylinders which improve distant vision most are selected. In compound hyperopic the spherical may be weakened, and in compound myopic this is frequently necessary, especially for near work.

Mixed astigmatism ordinarily receives the full correction. As a general rule, all cases of astigmatism ought to be thoroughly tested with the accommodation paralyzed.

IRREGULAR ASTIGMATISM.—A low degree of this defect occurs in the majority of eyes. This is often more manifest when the pupil is dilated, or when the eye is being tested under atropin. It will be found impossible to bring the vision up to what it was before the mydriatic was instilled.

Higher degrees reduce the vision very much. The stenoraic hole increases vision, but such spectacles are impracticable on account of their small field. Sometimes one meridian of regular curvature can be found, and, if so, the vision is benefited, by means of a cylindrical lens, which can be prescribed. Irregular astigmatism is frequently produced by the cicatrices of ulcers of the cornea. The congenital form is due to irregular refracting power in different parts of the lens.

ANISOMETROPIA.—By this term is meant a difference in the refraction of the two eyes, one being more hyperopic or myopic than its fellow, or a different form of ametropia existing in each eye.

When the difference is slight, it is usually possible to fully correct each eye. When the difference is considerable, an attempt may be made to do so, but if it is impossible the stronger glass should be weakened. Sometimes the choice of eyes to be corrected lies with the vision, the best eye receiving the proper correction. Again, it may be advisable to correct one for distance and the other for near.

Each case is usually a law unto itself, and should be dealt with accordingly. The difficulties are usually due to the absence of binocular vision and the prismatic effects of the correcting lenses.

PRESBYOPIA.—There is a diminution in the amplitude of accommodation, which, commencing at an early age, progresses with advancing years. It is caused chiefly by a progressive loss of elasticity of the lens, and the different layers becoming more homogeneous. Late in life the ciliary muscle becomes less powerful, and this adds to the difficulty. The effect of this progressive diminution is to cause the near point to recede from the eye. From the tenth year there is a steady decline in the dynamic refraction and a relative recession of the near point. Emmetropic eyes will ordinarily require presbyopic glasses about the fortieth to forty-fifth year of life.

Symptoms.—The presbyope holds all near work farther away than the usual distance. From this recession of the near point, the print becomes pale and indistinct. The patient seeks strong illumination and he suffers from asthenopic symptoms, *i. e.*, pain, fatigue, lachrymation, dimness of vision, irritation of the lids, etc. Presbyopia has no effect upon distant vision.

Treatment.—Presbyopia is corrected by wearing convex spherical lenses for near work, which compensate for the lack of power of accommodation and bring the near point back to the proper working distance. As the distance different people desire to use their eyes, or that the work they are engaged in requires, varies, the tables usually found in the text-books are misleading. Let each case be a law unto itself, and give them the glass that affords the easiest and best vision.

As the correction of presbyopia should be added to the refractive error at distant vision the eyes should always be examined at distance as well. Glasses should always be selected with reference to the occupation or special use for which they may be needed. As presbyopia increases with the age, the glasses will require changing every few years.

The relation of the muscles of convergence to presbyopia is a most important practical point too little considered by the majority of oculists. The muscular balance should always be carefully tested both with and without the glasses on. If exophoria is present the weakest convex lens possible should be prescribed. If esophoria be found the lens correcting the esophoria if possible should be ordered. In a general way in exophoria the weakest lens possible to give clear vision and in esophoria the strongest. Further consideration of this most important point will be found described in the chapter on the muscles.

CHAPTER IV.

METHODS FOR DETERMINING THE REFRACTION AND ACCOMMODATION.

These methods are of two kinds—*subjective* and *objective*. The subjective examination of the refraction which should always be employed is based upon the acuteness of vision and depends upon the statements of the patient.

In testing the acuteness of vision, which is the first step to be taken, the patient should be seated with his back to the light and the test-type for distance placed opposite him at a distance of five metres or more, as space will permit. Testing each eye separately, the patient is asked to read the smallest line of letters he can. His acuteness of vision (*V*) is expressed by a fraction, the numerator of which represents the distance of the test-card and the denominator, the distance at which the line of type he read should be distinguished.

The abbreviations *O. D.* and *O. S.* respectively stand for the right and left eye, and are utilized for designating the eye examined. The abbreviation *O. U.* stands for both eyes used simultaneously.

In ascertaining the static refraction, each eye must be tested separately, as in the case of the acuteness of vision. Considerable advantage is obtained by commencing the test with convex spherical lenses, as these cannot be overcome by an effort of the accommodation. If these lenses increase the acuteness of vision, or do not make it worse, the refraction is hyperopic. Should the weakest convex lenses make the vision worse, concave spherical lenses should be employed. In the event of their failure to improve, convex cylindrical lenses are next utilized and lastly concave cylinders.

Even though the acuteness of vision is normal in the first place, it is still necessary to place convex lenses in front of the eye in order to determine if there is any manifest hyperopia present. Under such circumstances the strongest convex lens through which the said line of type can be read is the measure of the manifest hyperopia. If convex lenses improve the vision to a certain degree, but short of the normal, recourse should next be had to convex cylindrical lenses in addition to the strongest sphericals found, which may bring it up to normal, the case being one of compound hyperopic astigmatism. The cylinder must be rotated in front of the spherical until the axis of the astigmatism is found. The strongest convex cylinder should be ascertained as in the case of convex spherical.

In the event of failure with convex glasses, concave ones should be employed. The weakest concave glass which produces the maximum acuteness obtainable is the measure of the myopia.

If the vision is improved somewhat by concave glasses, though not up to normal, concave cylinders should be tried in addition to the weakest spherical obtained in the first place, and the combination may bring the vision up to normal. This would indicate compound myopic astigmatism.

Failing with both convex and concave sphericals, convex cylinders should be employed and the strongest lens giving the greatest improvement denotes the degree of simple hyperopic astigmatism.

Simple myopic astigmatism is tested in a similar manner, but here the weakest concave cylinder is the measure.

In testing as if for simple hyperopic astigmatism, a certain improvement may be obtained, but less than normal. Leaving the strongest convex cylinder so ascertained in position, concave cylinders are added in a position at right angles to the former until the maximum improvement is obtained and we have the degree of mixed astigmatism.

The presence of astigmatism may also be discovered by asking the patient to look at the clock-face test-type, made up of lines, in series of three, radiating from a center in various directions. If astigmatism is present, one set of lines will stand out clear and distinct, while the others, but especially those at right angles to the first, will be indistinct. These designate the principal meridians of the astigmatism.

After the astigmatism is determined, the correct lenses should be placed in the frames and have the patient look at the clock-face, when, if the astigmatism is properly corrected, the lines will all appear similar.

CYCLOPLEGICS. — By cycloplegics are meant those drugs which produce temporary paralysis of the ciliary muscle, and therefore suspension of the accommodation. The importance of this in determining ametropia has been stated in the preceding chapter. The drugs most commonly employed are the sulphates of atropin, hyoscyamin and duboisin and the hydrobromates of homatropin and scopolamin.

(1) *Atropin* is usually employed in a strength of four

grains to the ounce. Ordinarily it paralyzes the accommodation in about two hours and the effects remain for a week. Two or three drops should be used in each eye the night before and the morning of the examination.

(2) *Hyoscyamin* and *Duboisin* are used one-half the strength of atropin. Their action is much more rapid than atropin and their cycloplegic effect more transitory.

(3) *Scopolamin* may either be employed in a one per cent. solution, a single drop being instilled, or in one-fifth per cent. solution, one drop every fifteen minutes for an hour and a-half. Cycloplegia occurs in about forty-five minutes and lasts from three to five days. Toxic symptoms sometimes develop, so considerable care should be exercised.

(4) *Homatropin* used in three per cent. solution, one drop being instilled every fifteen minutes for an hour and a-half preceding the examination, can be employed when a very transitory effect on the ciliary muscle is desired. The cycloplegic effects of homatropin pass off in about fifty hours, and are in a degree neutralized by eserin.

Cycloplegics must be used with caution in elderly people on account of the danger of precipitating an attack of glaucoma. Of course, they must never be employed if glaucoma is suspected or present.

The Objective Methods of Determining the Refraction of the Eye.—First. *The Direct Method.* In this the ophthalmoscope should be brought as close to the eye as possible, best as near as 13 mm., and on looking into the eye the various lenses of the ophthalmoscope are rotated before the sight-hole until one is found that brings the edge of the disc, or the vessels between the disc and macula, distinct. It is necessary for accuracy in this method that the accommodation of both the patient and surgeon be completely relaxed. To secure this the examination must be made in a dark room with the patient's vision fixed on the opposite side of the room and even then if spasm of the accommodation exists the results are unreliable. The surgeon must also look as though at some distant object and the power of relaxing the accommodation in some is never acquired and in all only by long practice. If the observer has any refractive error it must first be corrected or allowance made for it in computing the final result. If these points have all been secured the strongest convex or the weakest concave lens represents the glass the patient requires. The results, however, should always be verified by a trial of the glasses selected.

Second. *The Indirect Method.* This method is rarely resorted to because of its difficulties. The estimation is made by measuring the distance at which the emergent rays are brought to a focus of the object glass as compared with its principal focus.

SKIASCOPY (*Retinoscopy, or the Shadow Test*).—This is the most valuable of all the objective methods and determines the refraction by observing the direction in which the light appears to move across the pupil when the mirror is rotated in various directions. The test should be made in a dark room at a distance of one metre from the patient. Either a plane or concave mirror can be employed, but the preference is with the former. The light is covered with an opaque asbestos shade having an aperture 1 cm. in diameter. If the plane mirror is used the light should be near the surgeon, but if the concave mirror is used, behind the patient.

By rotating the mirror the area of light it throws on the face is made to move in the direction the mirror is rotated. Those rays which enter the pupil form a small light area on the retina, which also moves when the mirror is rotated. This area moves with the light on the face when the plane mirror is used and in the opposite direction if the concave mirror is employed.

When the plane mirror is used the apparent movement in the pupil and the real movement on the retina are the same when the observer sees an erect image, and in the opposite direction when he sees an inverted image.

The reverse of this obtains with the concave mirror.

The rays of light coming from a myopic eye are convergent and cross each other at its far point, and proceed divergently. The point at which they cross and which corresponds to the far point, is known as the *point of reversal.* The distance of the far point from the eye represents the focal length of the glass required to correct it, and, therefore, if the point of reversal is known the amount of myopia is also known.

In the following description it is assumed that the plane mirror is used, though it will apply equally to the concave mirror if we reverse the movement in the pupil and change the lenses. If the mirror is held closer to the eye than its point of reversal, an erect image is seen, and the light in the pupil will seem to move with the light on the face. Beyond the point of reversal, an inverted image is seen, and the light will appear to move in an opposite direction to the light on the face.

At the point of reversal it is impossible to see which way the light moves, and the illumination is much more feeble. At a distance of one or two metres from the point of reversal the illumination is very bright, but as the distance increases it becomes more and more feeble. Without altering the rapidity of the movement of the mirror, the apparent movement of the light is more rapid as we approach the point of reversal.

While the test depends mainly on the direction of the movement of the light in the pupil, the degree of illumination and the rapidity of movement aid in arriving at a diagnosis.

Myopia is estimated by finding the nearest point that an inverted image is seen and the most distant point at which an upright image is seen. Midway between the two is the point of reversal, whose distance from the eye should be noted on the tape for that purpose, and the number of dioptres corresponding is the measure of the myopia.

When the myopia is of high degree, the point of reversal lies very close to the eye, and in this situation a slight error in marking the distance may mean an error of a dioptre or more in estimating the myopia; whereas if a similar error is made when the point of reversal is situated at a metre or more from the eye it is unimportant. Therefore, in high degrees of myopia, in order to check results, it is well to correct all but about one dioptre by placing a suitable concave lens in a frame before the eye and measure the remainder, which is to be added to the lens in the frame.

If the myopia is less than one dioptre, the point of reversal lies so far away from the eye that when near it one cannot see which way the light moves. In this case put a weak convex glass in the frame to increase the myopia, then determine the point of reversal, and deduct the convex glass from the amount of myopia found.

Hyperopia gives an upright image no matter how far we recede from the eye, because the rays leave it divergently. In order to obtain a point of reversal, it is necessary to convert it into an artificial myopia by putting a convex glass in the frame and then finding the point of reversal as in myopia. The amount of myopia is to be deducted from the convex lens, the hyperopia being represented by the remainder.

Emmetropia acts the same as hyperopia, but when a convex lens is added the myopia produced equals the strength of the lens, proving that the rays were parallel in the first place.

In Astigmatism the refraction of the principal meridians is obtained in the same way as in myopia or hyperopia. In order to determine the refraction of a certain meridian, it is necessary to rotate the mirror about an axis at right angles to it, which causes the light to traverse the length of the meridian. The direction of the meridian is revealed by the area of light assuming a *band-like* shape as its point of reversal is approached. This is most marked in the higher degrees of astigmatism. Near the point of reversal, where the band-like appearance is most distinct, it is easy to cause the apparent movement from side to side, but more difficult in the direction of the length of the band. The latter, however, is to be watched, as it determines the point of reversal.

If the astigmatism is of low degree, this band-like appearance may not be perceptible; but when we have determined the point of reversal of one meridian it will be found that there is still distinct movement, either upright or inverted, in the direction at right angles to this. As a final test the cylinder correcting the astigmatism should be put in the frame together with the concave or convex lens which will remove the point of reversal to about 1 metre, and the movements watched again.

When using the concave mirror the position of the observer does not admit of much change, the distance being generally one metre. The movements of the light are the reverse of those just described.

Ophthalmometry.—The term indicates mensuration of the eye, but it is usually employed to mean the measurement of the radii of curvature of the cornea and the corneal astigmatism present in an eye with the ophthalmometer.

The ophthalmometer merely measures the corneal astigmatism and not the refraction of the eye. Corneal astigmatism may be modified by lental astigmatism, consequently the ordinary test with the trial lenses should always be made in addition.

Ophthalmometry is serviceable in revealing the corneal astigmatism and the principal meridians.

General Considerations.—After all tests are completed a proper record of them should be made in the surgeon's case-book.

Patients should be instructed to return with their glasses after they have obtained them from the optician, in order that the surgeon may ascertain if the lenses have been correctly ground and that the frames are properly fitted. The importance of this cannot be overestimated. The correctness of the lens is verified by neutralizing it with the opposite form of lens, that is, convex spherical and cylinders either alone or in combination are neutralized by concave sphericals or cylinders of the same number. If one holds a convex glass near one eye, and fixes an object like the edge of a door, the edge will appear to move in an opposite direction to the lens when the latter is moved from side to side. With a concave lens it moves in the same direction. If a convex and concave lens of equal strength, held together, are moved in a similar manner, the object will remain stationary, the effect of the convex being neutralized by the concave. Thus the number of any lens can be ascertained by neutralizing it with the lenses from a trial case, which are always numbered.

The frames should be so fitted that the pupil is opposite the geometric centre, and the optical centre should coincide with the latter unless it has been purposely decentered. This is the rule when glasses are to be worn for distance or constant use. Near glasses are usually decentered in about 4 mm. on account of the convergence of the visual lines. Reading glasses are also tilted forward and placed lower down than the distance glasses, to conform with the depression of the visual line. Lenses are often decentered in a given direction when a prismatic effect is desired.

Spectacle frames are always preferable to eye-glasses, and in fact their use is imperative in high grades of astigmatism. Still the prejudices of many patients, particularly women, against them must be regarded if we wish them to wear glasses, so under these circumstances eye-glasses must frequently be prescribed.

When separate glasses for reading and distance are required a "bifocal lens" for constant use may be prescribed to avoid the inconvenience of changing from one to the other.

CHAPTER V.

DISEASES OF THE EYELIDS.

Anatomy.—The eyelids serve to protect the eye from injury, both from excessive light and foreign substances; they also serve to distribute to the eyes the moisture secreted by the various glands.

The eyelids, or palpebræ, are two thin movable folds, the upper being the larger and more movable of the two; their movement is both voluntary and involuntary, the latter action being due to the orbicularis muscle. The angles of junction of the upper and lower lids are called *canthi;* at the *inner canthus* is found on both the upper and lower lid a slight elevation, the apex of which is pierced by a small orifice, the *punctum lachrymale*, the commencement of the small channel or *canaliculus* leading to the tear sac.

The eyelids are composed of four layers, arranged from without inward in the following order, the integument, a layer of muscular fibres, the tarsus, or as often erroneously called the tarsal cartilage, and the conjunctiva.

The muscular fibres consist of the *orbicularis palpebrarum*, a large flat, voluntary muscle extending over the orbital margins above and below and terminating by tendinous attachments at the angles of the lids, and inserted in the adjacent bony wall. Its fibres being more or less circular in arrangement, and, acting as a sphincter, serve to close the eyes.

The *levator palpebræ superioris* arises at the apex of the orbit, and passing along its upper wall becomes intermingled in front of the tarsus with the orbicularis. This muscle, as its name implies, serves to raise the upper lid. The lower lid is supplied with a prolongation from the inferior rectus, whose insertion and action is analogous to that of the levator palpebræ.

The *tarsi* are two thin, elongated plates composed of condensed fibrous tissue, and serve to form the framework of the lids; they are united to each other and to the adjacent bone through the medium of the internal and external lateral ligaments.

The *conjunctiva* is a delicate mucous membrane which commences at the free border of the lid, where it is continuous with the skin; it lines the inner surface of the lids and is then reflected upon the globe, over which it passes and becomes continuous with the cornea. Where it passes from the lids to the globe it is thin and loose, and forms what are called the *fornix* conjunctivæ. The *plica semilunaris* is a verticle fold of conjunctiva at the inner canthus, and the reddish elevation at the inner angle is called the *caruncula lachrymalis*.

The *cilia* are short, thick, curved hairs, arranged in double or triple rows at the margins of the lids. The various glands of the lids by their secretions serve to lubricate the eye. They discharge their secretion through excretory ducts, opening by minute orifices upon the free border of the lids.

BLEPHARITIS.—(*Blepharitis Ciliaris*, *Blepharitis Marginalis*, *Blepharitis Ulcerosa*, *Blepharitis Hypertrophica*), is a term usually applied to an inflammation involving the border of the eyelids.

Symptoms.—The condition commences as a simple hyperæmia of the lid border, which gives to the lids a red, swollen appearance. This is accompanied by a slight burning and smarting, aggravated by cold winds, smoke, dust, exposure to bright light, or use of the eyes at close work. There is agglutination of the eyelids in the morning, with dry scales or scabs adhering to the margins of the lids.

If we remove with the forceps the yellow crusts surrounding and embedding the cilia, we find a red, bleeding ulcerative surface. This surface continues to secrete pus that forms other crusts, and by extension of the ulceration the entire edge of the lid may become involved. At this stage the disease is known as *blepharitis ulcerosa*, and as it advances the edge of the lid not only becomes red and covered with scales, but considerably thickened, and it is then termed *blepharitis hypertrophica*. If the disease still continues unchecked, it involves the hair follicles and causes the lashes to become stunted and misplaced (*trichiasis*), or to fall out, and when entirely wanting we have the condition known as (*madarosis*). The final stage of the disease is when the lid itself becomes rounded, red, thickened, everted and deprived of lashes (*lippitudo*).

Course.—The course of the disease is usually very chronic, and yet should be cured by thorough and prolonged treatment.

Causes.—The disease is especially the result of refractive errors in young, delicate persons of a strumous diathesis.

Treatment.—First, we should correct any refractive error, as in many cases this alone will cure the entire trouble.

In rare cases the presence of lice on the eyelashes may be the exciting cause (*phthiriasis ciliarum*), when we should apply some mercurial ointment.

Catarrh of the lachrymal sac, stricture of the duct and ectropion, may cause an inflammation of the margins and eventually of the whole structure of the lids by causing the tears to flow over the edges of the lids. In all such cases the first thing to be done is to open the canaliculus into the sac, and, if necessary, the nasal duct into the nose, so as to give a free passage for the tears into that organ, after which the treatment is the same as in uncomplicated cases.

But the most common causes of ciliary blepharitis are exposure to wind, dust, smoke, etc., especially when complicated with *want of cleanliness;* therefore, the lids *must be kept clean.* This is best done by moistening the crusts with warm water and then carefully remove them with fine linen.

In the treatment of *chronic* inflammation of the margins of the lids *external applications* may be of value.

Cosmoline or Vaseline.—Either may be used alone or to form a base for the administration of other remedies. They prevent the formation of new scales and the agglutination of the lids and like all other ointments, should be used once or twice a day.

For years Mercury has been a favorite local application in blepharitis. The following prescription has been employed with the most favorable results.

℞. Hydrarg. oxyd. flav., ... gr. ij.
Vaselin, ... ℥ij.
Misce.

Graphites, as will be seen in the symptomatology, is more commonly indicated in blepharitis than any other one remedy and may be used locally as an ointment.

℞. Graphites, ... gr. ij.
Vaselin, ... ʒij.
Misce.

The use of milk, cream, lard and simple cerate, to prevent the lids from sticking together, have also been of aid to internal medication.

Graphites.—Especially in chronic cases. In scrofulous subjects covered with eczematous eruptions chiefly on the head and behind the ears; which are moist, fissured and bleed easily. Edges of the lids are slightly swollen and covered with dry scales or scurfs. The outer canthi have a great tendency to crack and bleed, upon any attempt to open the lids.

Mercurius sol.—Especially in syphilitic subjects. The lids are thick, red, swollen and ulcerated, and sensitive to heat or cold and to touch. Profuse acrid lachrymation.

Hepar sulph.—In acute phlegmonous inflammation, especially after the first stage has passed and suppuration is about to, or has already, taken place. The lids are inflamed with throbbing pains, and very sensitive to touch; aggravated by cold but ameliorated by warmth.

Pulsatilla.—There is a great tendency to the formation of styes. Blepharitis resulting from high living or fat food and when accompanied by acne of the face. The discharges are profuse and bland.

Calcarea carb.—Blepharitis in unhealthy, "pot-bellied" children of a scrofulous diathesis who sweat much about the head. The lids are red, swollen and indurated.

Calcarea iod.—In blepharitis with enlargement of the glands and especially of the tonsils.

Rhus tox.—In acute phlegmonous inflammation of the lids and erysipelas; lids œdematously swollen and accompanied by profuse lachrymation.

Mezereum.—In eczema of the lids and head, characterized by thick hard scabs.

Aconite.—In acute cases, the lids are red and swollen, with a tight feeling in them, while great heat, dryness, burning and sensitiveness to air are present.

Other remedies have frequently been of service to the writer, among them *Antimon. crud.*, *Apis*, *Argent. nit.*, *Alumina*, *Cham.*, *Euph.*, *Psor.*, *Sepia*, *Silicea*, *Sulph.*

OPHTHALMIC HERPES ZOSTER.—Commences with severe neuralgic pains along the supraorbital division of the fifth nerve of one side, sometimes the nasal and rarely the infra-orbital branch of the same nerve. The skin becomes swollen and red, covered with herpetic vesicles which unite, crusts form upon them, followed by ulcerations which ultimately leave deep cicatrices. The cause of the disease is probably an inflammation of the nerve and the Gasserian ganglion belonging to it. The disease involves one-half of the face, never extending beyond the median line, and has often associated with it corneal ulcers and iritis. The intense pain that precedes the herpetic eruption may last for a few hours, or extend over months, but usually subsides with the appearance of the vesicles. It is more often seen in elderly people.

Treatment.—The remedies most useful are: *Croton tig.*, *Ranunc. bulb.*, *Rhus.*, *Ars.* and electricity.

ABSCESS OF THE LID—(*Phlegmon*, *Furuncle*).—Suppuration in the connective tissue of the lid is generally the result of trauma. It may also follow debilitating diseases, or be associated with adenitis in scrofulous children. There will be great swelling of the lid, with more or less heat, redness and pain. Fluctuation may be detected early, and inflammation of the conjunctiva is apt to be associated with this disease. General inflammation of the lid may sometimes be seen in children without suppuration; while in cachectic subjects we may have a gangrenous condition.

Treatment.—Cold (iced) applications are recommended if the disease is seen at the outset; but if we suspect that the formation of pus has commenced, a change to hot applications (poultices) should be made.

As soon as fluctuation can be felt, a free incision into the swelling parallel to the margin of the lids should be made. A compress bandage should also be employed if the abscess is extensive.

If it has already spontaneously opened, the perforation should be enlarged, if it be insufficient and unfavorably situated; also if there be several apertures, they should be united by an incision, in order to leave as small a cicatrix as possible. A generous diet should be prescribed. For remedies, see *blepharitis*.

HORDEOLUM—(*Stye*, *Acne*). — Is an acute inflammation of the cellular tissue of the lid, surrounding a hair follicle, leading to suppuration and pointing at the edge of the lid.

Symptoms.—At first it appears as a hard, circumscribed redness and swelling, which frequently extends so that the whole lid will become œdematously swollen. There is at first much severe throbbing pain. Occasionally there are two or more at the same time, and they often occur in successive crops.

Course.—They usually point and break in three or four days, though they may undergo absorption without breaking.

Causes.—It is especially found in young people, and is usually due to general debility, associated with overuse of the eyes.

Treatment.—If the case is seen at its very outset cold compresses or dry heat will sometimes abort the attack; though usually more benefit is derived, especially after its commencement, from poultices.

If pus has formed, as shown by a yellow point, an incision should be made to permit its escape. If dependent, as it frequently is, upon impairment of the general health, proper hygienic measures must be advised.

Pulsatilla.—If given early, before the formation of pus, will often cause them to abort; as a remedy for the prevention of the recurrence of successive crops, it is of great value. It is especially useful if dependent upon some gastric derangement, and if accompanied by acne of the face; also when found in amenorrhœic females.

Hepar.—If suppuration has commenced, with throbbing pain, great sensitiveness to touch and amelioration by warmth.

Rhus tox.—In the early stages when there is an œdematous swelling of the lids.

Graphites, *Staphisagria*, *Sulphur*, *Thuja.*

PTOSIS is a drooping of the upper lid, due to either partial or complete paralysis of the levator palpebræ superioris. It may occur alone or be associated with a paralysis of the other muscles supplied by the third nerve, and is sometimes congenital. When complete, the upper lid covers nearly the whole of the cornea. The most frequent causes are syphilis and trauma. The so-called spurious ptosis is a drooping of the lid due to increased weight. This condition is found in chronic trachoma, from new growths, from a relaxed fold of the skin, etc.

Treatment. — Internal medication, electricity and operative measures.

Causticum.—Its special indication is drooping of the lid, resulting from exposure to cold.

Rhus tox.—Especially if found in a rheumatic diathesis, and if the cause can be traced to working in the wet, getting the feet damp, or to change in the weather.

Alumina.—Burning dryness in the eyes. Absence of lachrymation. Particularly useful in old, dry cases of granulations.

Euphrasia, Ledum, Spigelia, Gelsemium.

Operative Measures.—The old method was simply the removal of a portion of the skin and fibres of the orbicularis muscle, and this, in some cases of partial ptosis, may suffice.

Pagenstecher, in 1881, introduced the operation of inserting subcutaneous sutures.

Wecker combines the operation of sutures with the old method of excision.

BLEPHAROSPASM.—Spasmodic closure of the lids, due to reflex irritation of the ophthalmic division of the fifth nerve. It is often dependent upon some conjunctival irritation, or it may be due to a foreign body, an ulcer of the cornea, iritis, refractive errors, carious teeth, hysteria, or other reflex conditions.

Treatment.—This should first be directed to the cause of the irritation.

Agaricus.—Twitchings of the lids, with a feeling of heaviness in them, relieved during sleep, spasms of the lids.

Alumina, *Cicuta*, *Ignatia*.

Galvanism is often of great value in some cases. Canthotomy, the division of the structures at the outer canthus by means of scissors is of value in tonic spasm.

NICTITATION.—Constant blinking is frequently met with, especially in children and nervous, delicate persons. Generally due to some irritation in the eye itself, or may be reflex, from worms, decayed teeth, etc. Remove the cause, if determinable, and *Agaricus* will complete the cure.

BLEPHAROPHIMOSIS. — Narrowing of the palpebral opening from contraction of the skin of the lid is usually caused by chronic conjunctivitis, especially when flabbiness of the skin in old age favors such a formation and is relieved by canthotomy.

SYMBLEPHARON.—Adhesion, partial or complete, of the eyelid to the eyeball. Due to burns from acids or lime, from diphtheritic or trachomatous conjunctivitis, when there has resulted destruction of two opposed portions of the ocular and palpebral conjunctivæ. The lower lid is most commonly adherent. Owing to the restrictions in the movement of the eye, and the possible loss of vision, every means must be tried to prevent adhesions in burns of the conjunctiva. To accomplish this the wounded surfaces must be separated daily during healing by some mechanical means, and the application of oil or vaseline to prevent their sticking together. The mucous membrane in these cases is destroyed to such an extent that simply dividing the adhesions will do no good, as they will at once grow together again. Treatment is operative.

ANKYLOBLEPHARON is an adhesion of the ciliary margins of the eyelids. It may be complete or partial, often combined with symblepharon, and is acquired from burns or wounds, or congenital. The adhesions should be divided.

LAGOPHTHALMOS is an incomplete closure of the palpebral fissure. It may result from a paralysis of the orbicularis, cicatrices in the skin of the lids, exophthalmos, staphyloma, etc. The danger of this condition is from ulceration of the cornea, due to its exposure to air and external irritants.

Treatment.—In paralytic cases galvanism, with remedies directed to the cause of the paralysis (such as syphilis, rheumatism, etc.), will often result in a cure.

EPICANTHUS is a congenital deformity in which a crescentic fold of skin projects in front of the inner canthus. It may also be seen in persons with flat noses, such as Mongolians, or syphilitics.

TRICHIASIS AND DISTICHIASIS.—Where there is an irregularity in the shape and position of the eye-lashes so that they become curved in and in contact with the eye, it is called trichiasis, and where there is a double row of lashes, one of which is in contact with the eye, it is called distichiasis. Inverted cilia may affect part or the whole of the lid, and are usually thin, pale or stunted. They cause more or less irritation of the eye, sometimes ulcers, pannus, etc., and are usually due to blepharitis, trachoma, injuries, burns, etc.

Treatment.—Epilation, often repeated, may cause an atrophy of the hair bulbs.

Electrolysis is most serviceable when the lashes are not too numerous.

Arlt's operation, when modified to meet the exigencies of the case, seems to be the most generally advisable method of operating for the severe cases.

ENTROPION is an inversion of the eyelid. We find two varieties, the spastic, usually of the lower lid and due to a spasmodic contraction of the orbicularis muscle. Often met with in old people, and due to the lax condition of the skin. It may also be due to irritation from a foreign body, from keratitis, etc. Cicatricial entropion comes on gradually during the process of cicatrization and is the result of granular and diphtheritic conjunctivitis, burns, etc. Entropion results in much irritation and pain in the eye from the inverted lashes. Ulcers and pannus may ensue.

Treatment.—In the spasmodic entropion a cure may often be effected by painting the parts with collodion, which should be renewed every two or three days, or oftener, in order to keep the lid in position. Adhesive strips may be applied for the same purpose. There are various operations for the relief of entropion, of which perhaps Green's is the most serviceable in the majority of cases.

Other operations are Streatfeild's, Arlt's, Holtz, Snellen, Pope and others.

ECTROPION is an eversion of the eyelids. The eversion may be slight or so great as to expose almost the whole of the palpebral conjunctiva. Ectropion is also divided into two classes, the spastic, due to chronic inflammation and swelling of the conjunctiva, also sometimes seen in children. The cicatricial ectropion is due to a contraction after loss of the skin of the lids or of the face, following burns, wounds, abscesses, caries of the edge of the orbit with adhesions of the skin, etc.

Treatment.—Spastic ectropion may sometimes be relieved by replacing the lid and retaining it there for several days by the use of the compress bandage. Scarification or removal of a strip of the conjunctiva, together with the slitting up of the canaliculus, may be tried. Other operations are legion, and must vary according to the cause, degree and position of the eversion.

Wharton Jones's and Diffenbach's are most frequently indicated.

Little reliance must be placed upon internal medication in either entropion or ectropion, as operative measures are almost invariably necessary, except occasionally in the first stage.

MOLLUSCUM CONTAGIOSUM is an affection of the sebaceous glands. It consists of small, round, umbilicated whitish prominences which may become inflamed and go on to suppuration. For treatment see chalazion.

XANTHELASMA is a hypertrophy of the sebaceous glands and a fatty degeneration of the connective tissne of the skin. They appear as yellowish patches, especially on the upper lid. They may be removed when small by excision, for cosmetic pnrposes.

MILIUM are small, circular, white tumors. They are removed by incision and pressing out of the contents.

PAPILLOMATA (warts) are occasionally found upon the edge of the eyelid and upon the conjunctiva. They should be snipped off.

DERMOID CYSTS are congenital, contain hair-follicles, hairs, connective tissue, fat, etc. Generally at the outer angle of the orbit, develop slowly and cause but little inconvenience. They should be removed without rupturing the tumor, if possible.

NÆVI are found on the eyelids and are similar in appearance to those occurring elsewhere. They are best removed by the galvano cautery or nitro-muriatic acid.

CHALAZION (*Meibomian or Tarsal Cyst*).—Is a small tumor due to an inflammation of a Meibomian gland and the tissue surrounding it. It varies in size, rarely growing larger than a good-sized pea; several may occur at the same time or they may recur in successive crops. It is hard and tense to the touch, and the skin is freely movable over it, but the tumor is adherent to the underlying tissues. It develops slowly, causing no inconvenience for weeks or months.

Treatment.—Opening of the tumor, squeezing out its contents, and stirring up the sac with the point of a knife is usually sufficient, or a small chalazion curette may be introduced and the contents as well as the sac wall thoroughly scraped out. The opening of a chalazion should always be through the conjunctiva if possible. After opening, I usually give *Hepar* low to promote absorption of the sac.

Many cases have been cured and their recurrence prevented by medication alone.

It is my custom to apply the tincture externally at the same time the remedy is being taken in potency.

Staphisagria.—For little induration of the lids, resulting from styes, or for successive crops of small tarsal tumors, this drug is especially indicated.

Thuja.—This is one of the most valuable remedies for tarsal tumors, whether single or multiple, especially if they appear like a condyloma, either of the internal or external surface of the lid.

Hepar, *Conium* and *Pulsatilla*, have also proven serviceable.

EPITHELIOMA is the most frequent malignant growth affecting the eyelid. It rarely occurs before the age of forty, and appears first as small hard nodules, and later becomes covered with a scab, which, on being removed, shows a slight excoriation ; this increases to an ulceration of considerable depth, with purulent secretion and irregular, hardened edges. It may remain indolent for months, then assume an active stage, leading rapidly to extensive destruction of tissue. In the early stages there is little or no pain, but becomes excessively painful in the later stages.

Epithelioma, lupus and chancre have a very similar general appearance.

Differential Diagnosis.

EPITHELIOMA.	LUPUS.	CHANCRE.
Indurated irregular edges. Slow growth. Attacks middle-aged and elderly people. Lymph glands, of neck involved late.	Less induration. More inflamed. Growth slower than epithelioma Lymph glands involved late. Generally associated with lupus elsewhere in body.	Indurated, but edges more rounded. Rapid growth. Usually in younger subjects Lymph glands early involved. Other symptoms of syphilis.

Treatment.—Excision is advised in all malignant growths of the lids, if the disease is circumscribed and moderate in extent, care being taken that all the morbid tissue is removed.

Various caustics have been employed, chief among which may be mentioned caustic potash, nitrate of silver, chloride of zinc, arsenic paste and acetic acid. An objection to the use of caustics lies in the deformity apt to occur afterward. Electrolysis has been recommended. The use of the X-ray has resulted in the cure of epithelioma. Radium it is also claimed will cure epithelioma.

Iodoform, *Apis*, *Hydrocotyle*, *Phytolacca* and *Thuja* have all given good results in some cases.

LUPUS AND SARCOMA have both been found affecting the eyelids. A lupoid growth is more slow in development than an epithelioma, and both may result in ulceration. "A discrimination between them is hardly needful for practical purposes."

Treatment.—Same as for epithelioma.

SYPHILITIC ULCERS, CHANCRE AND GUMMATA, are all occasionally found on the eyelids, and should be treated the same as occurring elsewhere. The most useful remedies are the following, prescribed according to general indications: *Merc.*, *Kali iod.*, *Aurum*, *Nitric. ac.*, *Arsen.*, *Apis.*

CONTUSIONS are very often found, and are frequently accompanied by some lesion of the globe or orbit.

Treatment.—Cold compresses should be immediately applied with a firm bandage. *Arnica* and *Ledum* may be used both locally and internally.

WOUNDS.—We may have an incised, lacerated, or penetrating wound of the lid ; and, in all cases, the condition of the orbit and globe should be carefully examined to see if they remain intact.

Treatment.—The edges of the wound should be brought together by means of sutures, adhesive strips or collodion.

BURNS AND SCALDS must be treated as usual in other parts of the body, except that care should be taken to prevent the union of the lids (ankyloblepharon) by frequently opening them, and by inunction of the edges with simple-cerate or cosmoline ; also, great attention should be paid to the prevention of a cicatrix (which causes ectropion) by keeping the skin on the stretch by a bandage during the period of cicatrization. Cosmoline is especially recommended as an external application.

When dependent upon the stings of insects, the sting should be removed and cold water dressings applied.

CHAPTER VI.

AFFECTIONS OF THE LACHRYMAL APPARATUS.

Anatomy.—The *lachrymal gland* is lodged in a fossa at the outer and upper part of the orbit and close to its anterior margin. It is a compound tubulo-racemose gland like the serous salivary. The excretory ducts, some ten to fourteen in number, run from the gland to the upper and outer part of the superior fornix of the conjunctiva. The secretion of the lachrymal gland is faintly alkaline. It serves to moisten the anterior surface of the eye, and passes off through the puncta, canaliculi, lachrymal sac, and nasal duct, into the inferior meatus of the nose. The *puncta* are the two minute openings of the canaliculi, on the free margin and at the inner angle of the lids. The *canaliculi*, both upper and lower, extend from the puncta to the lachrymal sac, just before reaching which they unite. The *lachrymal sac* is the upper dilated portion of the nasal duct. It is located in a groove formed by the lachrymal and superior maxillary bones; its upper end is closed and rounded. The *nasal duct* extends from the lachrymal sac to the inferior meatus of the nose. The total length of the sac and duct is about one inch. Its direction is downward, backward and slightly inward. The tears are forced into the excretory passages by muscular action, aided by a kind of suction caused by the muscular fibres of the puncta and canaliculi.

DACRYOADENITIS.—Inflammation and abscess of the lachrymal gland is extremely rare. In the *acute* form the symptoms are great swelling and redness of the upper lid at its outer angle. The globe may be displaced downward and inward by the swelling. The pain is severe and increased by touch. The conjunctiva is inflamed and may be chemosed. The inflammation may terminate by resolution, suppuration, or run into the *chronic* form, merely a considerable swelling remaining. Dacryoadenitis is generally caused by injury, and this fact, together with its symptoms, makes it very difficult to diagnose from periostitis of the orbit or abscess of the lid.

Treatment.—In the early stage ice will often cut short an attack, which might otherwise go on to suppuration. As soon, however, as there is evidence of suppuration we should resort to hot fomentations, and, when well established, a free incision should be made through the conjunctiva, if possible. The most useful remedies are *Acon.*, *Apis*, *Hepar*, *Rhus* and *Silicea*.

HYPERTROPHY OF THE LACHRYMAL GLAND is very rare. It is a circumscribed, nodular tumor of gradual growth, and may be congenital or due to syphilis. If it increases sufficiently to cause interference with the movements of the eyeball, the gland should be removed.

TUMORS OF THE LACHRYMAL GLAND, such as fibroids, sarcomatas, adenomas, epitheliomas, have all been recorded. They require extirpation of the gland.

ANOMALIES OF THE PUNCTA AND CANALICULI.—Eversion of the puncta is frequently found in blepharitis and conjunctivitis, causing epiphora, or watering of the eye, and will often result in ectropium from the irritation of the tears flowing over the lid.

The same result will occur from a narrowing or stoppage of the canaliculus or puncta, from wounds, foreign bodies or catarrhal inflammation. Obstruction of the canaliculus can be relieved by slitting up the canal with the canaliculus knife, a narrow-bladed, probe-pointed knife, which is to be entered into the puncta vertically, the handle then brought to a horizontal position, when the knife is pushed directly inward until it reaches the inner wall (the lid being kept taut with the thumb of the other hand), the knife is then brought to the vertical position, cutting through the whole length of the canaliculus. The edge of the knife should be kept toward the eye during its passage so as to divide the canaliculus close to the muco-cutaneous junction. It is better, where possible, to preserve the physiological suction action of the canaliculus by only slitting it up for two or three mm. from the punctum and dilating the remainder of the canal with probes.

LACHRYMAL STRICTURE.—Stricture of the nasal duct is the most common affection of the lachrymal apparatus.

Symptoms.—The chief characteristic symptom of stricture is the overflow of tears. There is also often noticed a dryness of the nostril on the same side as the stricture. On making pressure with the finger over the sac we may press out from the puncta a few drops of clear viscid secretion.

It is usually due to the extension of a nasal catarrh. Injury or periostitis of the nasal bones, carious teeth, etc., may cause it. Its treatment will be found under *Dacryocystitis*.

CATARRHAL DACRYOCYSTITIS.—Catarrhal inflammation of the lachrymal sac is generally the result of a stricture, or, on the other hand, may be the cause of the stricture. The retention of the tears from obstruction causes a gradual distension of the sac—a swelling at the inner angle of the eye. By making firm pressure on this swelling the mucus can be pressed either out of the canaliculus or down through the nasal duct into the nose. This disease usually develops very slowly, with simply the history of having had a watery eye for a long while previous to noticing any swelling of the sac, and they may notice a dryness of the corresponding nostril. The swelling is usually free from pain or sensitiveness to touch.

Treatment.—As in nearly all cases a more or less firm stricture is present, this will require our special attention. The cutting of the stricture is only necessary in those rare cases that will not yield to probing and electrolysis.

The best operation to divide the stricture is that of Stillings, who, after slitting the canaliculus (as already described), introduces into the lachrymal sac a triangular shaped knife in the same way as a probe, and then forces it down two or three times in succession, the blade being turned in a different direction at each passage.

Blood issuing from the nostrils is proof that the passage has been opened. Care should be taken for a day or two after the operation to see that the canaliculus does not close, and, commencing on the second day after the operation, the duct should be probed every two or three days until it remains permanently opened.

A passage sufficient to admit of a Bowman probe, from No. 5 to 8 (varying in different cases), should be secured.

Larger probes have been recommedend, but in my experience they have not proved satisfactory.

In passing a probe stand behind the patient, the lid held down and out by the thumb of the other hand. The probe is entered into the canaliculus and passed inward until it is felt in contact with the lachrymal bone. Taking care that the point does not slip away from the bone, the probe is rotated upward to the vertical position and the point slips into the lachrymal sac.

A far better method than operating, when it can be carried out, is that of gradual dilatation of the strictures by using larger and larger probes. Commencing with No. 0 or 00, the canaliculus and duct can be gradually distended so as to admit of a No. 4 or 5 Bowman probe without even slitting the canaliculus. Rarely the punctum may have to be slightly nicked with the point of the knife so as to admit of the smallest sized probe. The advantages of this method rest in the fact that we do not destroy the function of the parts, and the normal suction action of the canal is retained.

Marked benefit has also been observed from electrolysis. My plan has been to insert a probe the usual way until it comes in contact with the stricture, then attaching the probe to the *negative* pole of a battery, apply the positive to the temple, and make gentle pressure as the stricture yields.

In the treatment of the blennorrhea, a free vent for the secretions being present, *the patient should be instructed to press out the matter several times a day.*

Mild astringent injections of boric acid, sulphate of zinc of a two to four per cent. solution or some similar preparation may sometimes prove very serviceable.

Pulsatilla.—One of the most important remedies in blennorrhea of the sac, if the discharge is profuse and bland. Especially beneficial in children.

Stannum.—In the yellow-white discharge from the lachrymal sac.

Hepar sulph.—After pus has formed, or in blennorrhea, with great sensitiveness to touch and cold, with profuse discharge.

Euphrasia.—Much thick, yellow, acrid discharge, making the lids sore and excoriated.

Other remedies which have proved useful are *Arg. nit.*, *Merc.*, *Sil.*

PHLEGMONOUS DACRYOCYSTITIS.—Is a purulent inflammation of the lachrymal sac and of the surrounding connective tissue, and results in an abscess that tends to break externally.

Symptoms.—There is a marked swelling which is extremely sensitive to the touch. Firm pressure over the swelling will usually empty the tumor either through the puncta or downward through the nose; there is also the previous history of a long-continued lachrymation. The integument becomes very tense and assumes a dusky-red hue. There is usually an edematous infiltration of the surrounding parts, viz.: eyelids, side of the nose and cheek. There is intense pain and heat, with sometimes general symptoms of chills, fever and vomiting. The conjunctiva may be inflamed and even chemosed.

Course.—If left to itself the swelling usually increases until the abscess breaks externally, leaving a fistula of the lachrymal sac, which is extremely difficult to heal.

Cause.—A catarrhal inflammation precedes a phlegmon. The decomposed secretions in the sac penetrate the mucous membrane and set up a purulent inflammation. The exciting cause is frequently a simple cold in the head.

Treatment.—At the very commencement cold compresses with the indicated remedy may stop the inflammation before an abscess has formed.

As soon, however, as pus has begun to collect in the lachrymal sac, the *first* step to be taken to prevent its breaking externally, with the formation of a fistula, is the opening of the canaliculus into the sac and the evacuation of its contents, through the natural channel. If perforation is inevitable, a free incision into the sac should be made externally, after which, and also in case the abscess has opened spontaneously, warm compresses may be employed for twenty-four or forty-eight hours. The opening should be kept open by the insertion of a strip of iodoform gauze every day until the subsidence of the inflammation; during this time the canaliculus should be slit and by the use of probes the natural channel reëstablished, thus permitting the healing of the fistula. Probing of the nasal duct should be avoided until the severity of the inflammation has subsided. Remedies are most serviceable, see *Catarrhal dacryocystitis.*

LACHRYMAL FISTULA.—An opening externally of the lachrymal sac, when the result of an abscess breaking, is often very obstinate and difficult to heal; hence, when evidently about to break, it should be opened with a bistoury.

Treatment.—The first point is to see that the passage is free into the nose. We must therefore slit up the canaliculus, divide any stricture found in the nasal duct and keep the canal open.

The fistula may now be healed, and, if recent, this is best done by touching the edges with a stick of nitrate of silver, or the gentle application of the galvano-cautery. In old cases it will be necessary to pare the edges and unite with a suture.

CHAPTER VII.

DISEASES OF THE ORBIT.

Anatomy.—The shape of the orbit is that of a quadrangular pyramid, the base or facial opening, the four walls and the apex. The bones entering into the formation of the orbital walls are the frontal, sphenoid, superior maxillary, malar, palate, ethmoid and lachrymal. The optic foramen, situated at the apex of the orbit, transmits the optic nerve and the ophthalmic artery. The superior orbital fissure transmits the third, fourth and sixth nerves, ophthalmic branch of the trigeminus, the superior and inferior ophthalmic veins, few sympathetic filaments from the cavernous plexus, the recurrent lachrymal artery and sometimes orbital branches of the middle meningeal artery. The inferior orbital fissure gives passage to the malar and infra-orbital nerves, infra-orbital vessels, a facial branch of the ophthalmic vein, and the ascending branches of the spheno-palatine ganglion. The supra-orbital notch, at the upper and inner margin of the orbit, contains the supra-orbital nerve, artery and vein as they pass to the forehead. The orbit, in addition to the eyeball, vessels, muscles, etc., contains considerable adipose tissue.

Tenon's Capsule is the limiting membrane between the cellulo-fatty tissue and the globe and conjunctiva. It ensheaths to some extent the muscles, vessels, nerves, etc., that pass through it, and is continuous with the periosteum of the orbit as well as with the conjunctiva. It is somewhat analogous to the pleura, and serves as a cup in which the globe revolves. It constitutes a secondary attachment for the ocular muscles, and by this attachment it renders it possible to sever the tendon of a muscle without losing its entire action upon the eye, for it still remains in connection with the eye through Tenon's capsule, unless too extensive lateral cuts have been made, separating the tendon from the capsule.

ORBITAL CELLULITIS (*Abscess or Phlegmon of the Orbit.*)—Inflammation of the cellular tissue of the orbit may occur as an *edematous* or *phlegmonous cellulitis.*

Symptoms.—In *edematous cellulitis* the eye will be slightly bulged forward, its movements limited and sometimes diplopia is complained of. Very little or no swelling, redness and pain. Generally occurs in young and delicate children, and usually subsides in a few days.

In *phlegmonous cellulitis*, the onset is apt to be accompanied with a chill and rise in temperature. There will be a firm, tense swelling, discoloration of the lids, and a more or less intense pain, greatly increased by pressure upon the globe. The eyeball is protruded *directly forward*, and its movements limited in all directions; in some severe cases it will have absolutely no motion. The conjunctiva may be excessively chemosed and if continued for some while the cornea is apt to slough. Diplopia is usually present and the vision may be greatly impaired from optic neuritis and retinal hemorrhages.

Causes.—Various and frequently obscure, but nearly always due to infection. May be metastatic from phlebitis, septicemia, puerperal fever, etc. It is often coincident with facial erysipelas. May result from cold, from injuries, periostitis, etc.

Diagnosis.—From panophthalmitis by the clear media; from periostitis by more swelling and redness, by protrusion directly forward and by limitation in all movements; from thrombosis of the cavernous sinus by absence of cerebral symptoms, and by proptosis and immobility of the eyeball; from purulent conjunctivitis by limitations of movements and much less discharge.

Prognosis.—Is always serious as vision may be lost from neuritis, slough of the cornea, or panophthalmitis. It may terminate fatally through meningitis and abscess of the brain, though the large majority recover.

Treatment.—When due to a foreign body, it should be removed, and the ice bag may be employed early. But if suppuration threatens, poultices should be applied with *early* evacuation of the pus by a *free* incision through the conjunctiva if practicable, if not, through the lid itself. Care should be taken that the pus has free vent at all times. The patient should be built up with milk punches, nourishing food, etc.

Rhus tox.—This is a remedy of the very first importance. The lids are edematously swollen, as well as the conjunctiva. The pains are especially severe at night and panophthalmitis threatens.

Hepar sulph.—Especially after pus has formed. Lids swollen and very sensitive to both touch and cold. The pains are of a throbbing character.

Phytolacca.—Cellulitis without much pain, slow in its course and with little tendency to suppuration. The infiltration into the orbit and lids will be hard and unyielding to touch.

Aconite, *Apis*, *Lachesis* and *Mercurius* have also been of great value.

TENONITIS.—Inflammation of the capsule of Tenon is a comparatively rare disease which may follow operations for strabismus and less frequently occurs idiopathically, especially in those of a rheumatic diathesis.

Symptoms.—There may be slight swelling of the lids, chemosis of the conjunctiva, exophthalmos and diminished mobility of the eye. Pain on pressure or movement of the eye, is apt to be present.

Treatment.—The most serviceable remedies are *Kalmia lat.*, *Kali iod.*, *Rhus* and *Puls.*

ORBITAL PERIOSTITIS.—May result from injuries or occur idiopathically in rheumatic, syphilitic or scrofulous subjects. Usually found in early life and at the margin of the orbit.

Symptoms.—Pain, especially from pressure on the bone, edema of the lids, chemosis and a tense, swollen, sensitive spot in which fluctuation may be detected later. In the acute form there may also be fever, vomiting, delirium, etc.

In the *chronic* form of periostitis there is simply slight swelling of the upper lid and supra-orbital pain, together with localized swelling at the seat of inflammation. This is the more frequent form, and especially found in young scrofulous subjects.

Diagnosis.—Periostitis in its *acute* form resembles very closely a phlegmonous cellulitis, and must be differentiated by the acute pain on pressure upon the orbital margin; by less swelling and redness of the lids; the inflammation is more circumscribed, so that the displacement of the eyeball is in one direction and its mobility is more restricted in one direction.

Course.—When chronic, it is very tedious, lasting months or years, and is apt to result in caries of the bone, fistula, deformity of the lids, etc. In the acute form, if the abscess is near the surface and promptly opened, it may heal in a short time; but if deep and neglected, or if occurring in one of a syphilitic or scrofulous constitution, will usually be much more serious.

Prognosis.—When near the orbital margin it is favorable, but if deep in the orbit it is much less so, as it may result in atrophy of the optic nerve, paralysis of the orbital muscles, or meningitis.

Treatment.—See *Caries.*

CARIES AND NECROSIS. — Usually the result of periostitis or an injury, although it may occur without a previous inflammation of the periosteum, especially in syphilitic or scrofulous subjects. After the abscess has opened, a fistula is formed which leads to the roughened and denuded bone. The discharge of pus through the fistula has the peculiarly fetid odor of osseous caries. The general symptoms of periostitis are present in caries, and, in addition, the diseased bone can be detected by the probe. Caries is most commonly found in children and necrosis in adults.

Treatment.—Give the pus free vent, the opening kept open and an injection of a solution of carbolic acid 1 to 100, or of the sulphate of zinc gr. x to ℥j may be used. Remove all loose pieces of bone. The remedies for cellulitis are also applicable to this disease, in addition.

Kali iod.—Is one of the most important remedies we possess for periostitis, especially the syphilitic variety.

The pain is usually marked, though may be absent entirely. The lids will often be edematous.

Aurum.—For both periostitis and caries. The pains are in the bones, are worse at night, bones sensitive to touch and the patient is excessively sensitive to pain.

Silicea.—The roughened bone and moderately profuse yellow-white discharge, the weakened general condition, relief from warmth and other concomitant symptoms will be present.

Mercurius and *Calc. hypophos.*

DISEASES OF THE ADJOINING CAVITIES.—*Empyema of the Frontal Sinus*, is the most frequent, due to inflammation within the nose. Transillumination by small electric light below brow at inner angle of orbit, in a darkened room, will show if sinus filled with pus as a large, dark spot; if cavity is normal the reflection of the light will be distinctly observed. May have caused headache for a long time or but little discomfort. If disease goes on it perforates at upper and inner angle of orbit, and causes swelling and displacement.

Treatment.—Open sinus at inner angle of orbit, give free drainage and irrigate with antiseptic solution.

Empyema of the Ethmoid open from inner angle of the eye and give free drainage into nasal cavity.

Empyema of the Maxillary Antrum, free drainage through the nose or canine fossa should be obtained.

TUMORS OF THE ORBIT.—In the orbit may be found both benign and malignant tumors, which may have developed primarily in the orbit, in some of the neighboring sinuses such as the antrum or ethmoidal, or have spread from the eyeball or face. They usually cause more or less exophthalmos and restriction in the mobility of the eye; the displacement of the eye depends upon the location of the growth. The eye may suffer from inflammation, the optic nerve may become inflamed or atrophic, the retina detached, etc. The examination should be directed to the degree and direction of the exophthalmos; to the impairment in motion, whether in one direction or all; to the feel of the growth, its smoothness, mobility, solidity, pulsation, fluctuation, etc.

We note the effect of pressure upon the eyeball, if it causes pain on being pushed backward, or if the position of the tumor is altered. We inspect the nostrils, the pharynx, the frontal and maxillary sinuses. The tumor may be explored with the hypodermic syringe. The history of the case should be elicited for the hereditary tendency, the progress of the growth whether slow or rapid, whether associated with pain or not. All these points and many more should be considered, as an aid to diagnosis, prognosis and treatment. Nearly all varieties of tumors may be found in the orbit, viz.: The most frequent *benign* tumors are angioma and osteoma, and the *malignant* are sarcoma and carcinoma.

Treatment.—Remove as early as possible, endeavoring to save the eye whenever sight is present, unless it be a malignant growth and there is danger of not removing the whole of the tumor without sacrificing the globe; in which case it is usually better to remove all the contents of the orbit.

Electricity is of great value in removing vascular tumors of the orbit.

WOUNDS AND INJURIES OF THE ORBIT may prove serious from inflammation of the orbital tissue, or periostitis, which they may cause. Penetrating injuries from knives, shot, pitchforks, etc., cause laceration of the soft parts. Injury causing fracture of the orbital walls may prove more or less serious according to the location and extent of the fracture; a slight lesion of the orbital margin may heal without trouble; in fracture of the frontal or ethmoidal cells we will usually have emphysema of the orbit and lids, due to an entrance of air into the cellular tissue. If the injury has occurred in the vault of the orbit, we may have a serious inflammation of the brain or its membranes. Fracture of the roof of the orbit has frequently been found with a fracture of the base of the skull. Hemorrhage into the cellular tissue is very apt to occur in all injuries or wounds of the orbit, hence exophthalmos is usually present. Foreign bodies of large size have frequently remained imbedded in the orbital tissues for a long while without creating any material disturbance.

Treatment.—When a foreign body has penetrated the orbit it should be removed as soon as possible, after which the ice bag should be applied and *Aconite* given.

Injuries with an effusion of blood into the orbit, causing the eye to protrude, will be benefited by a cold compress and a firm bandage. In emphysema of the orbit and lids a compress bandage will be required.

EXOPHTHALMIC GOITRE (*Graves' Disease*, *Basedow's Disease*).

Symptoms.—The main symptoms of this disease are: rapidity of the heart's action, enlargement of the thyroid and protrusion of the eyes, although any one of these symptoms may be absent. The acceleration of the heart's action is the earliest, most constant and essential symptom, and this may reach from 100 to 200 beats per minute and may be weak and irregular. The heart symptoms are usually first developed, followed later by the enlargement of the thyroid and the exophthalmos either simultaneously or in succession. The exophthalmos, due to vascular engorgement, is almost universally bilateral, though it may be confined to one side. The protrusion may be so excessive that the lids are unable to cover the eyes, and ulceration of the cornea may result from the exposure. The protrusion is straight forward, causes no interference with the movements of the eyes, and the eyes may be pressed back into their normal position, but will become prominent again on relief of the pressure. The exophthalmos gives the patient a frightened, staring appearance. On turning the eyes downward the upper lid does not follow it at all, or moves along for a certain distance and then remains stationary. This peculiarity, called Graefe's sign, is of much diagnostic value. Other symptoms of this disease are dyspnea and excessive nervousness. The disposition is often changed. The patient is easily frightened and flushes readily. Epistaxis or hemorrhage from other parts may occur. Anemia is often present, and rapid emaciation may occur in some cases.

Course.—Very chronic, lasting for several years, with frequent temporary improvements and relapses. The majority of these cases, however, practically recover.

Causes.—Some authorities claim that over 85 per cent. of all cases are found in women. The majority occur between the age of puberty and thirty in women, while the average age in men is from thirty to fifty.

This disease has been attributed to a disease of the sympathetic, to rheumatism, etc., but it will probably be found to be due to some central lesion. It is generally brought on by some mental shock, by exhaustion from disease, excessive hemorrhages, or severe labor.

Treatment.—To promote a permanent cure, rest, especially in the country; freedom from all excitement, especially emotional; exercise in open air; a generous diet, and abstinence from all stimulants, are particularly required and should be insisted upon whenever practicable. Electricity has been followed by very good success in many instances.

Amyl nit.—The eyes are protruding, staring, and the conjunctival vessels injected, as well as those of the fundus. Especially indicated when there are frequent flushes of the face and head, oppressed respiration, etc.

Badiago.—Exophthalmic goitre, with aching pain in the posterior portion of the eyeballs, accompanied by tremulous palpitation of the heart and glandular swellings. The pulse is rapid and irregular.

Ferrum.—Especially when the disease comes on after the suppression of the menses; protruding eyes, enlargement of the thyroid, palpitation of the heart and excessive nervousness.

Spongia.—Exophthalmos, enlargement of the thyroid and palpitation of the heart, great uneasiness and easily frightened.

Cactus grand. and Lycopus Virg. should also be studied.

CHAPTER VIII.

AFFECTIONS OF THE OCULAR MUSCLES.

Anatomy.—The movements of the eyeball are carried on through the action of six voluntary muscles; four of these passing directly from their origin, around the optic foramen, to their insertion in the sclerotic, are called the recti muscles and are distinguished by their relations to the eyeball, as internal, external, superior and inferior rectus.

The superior oblique arises at the optic foramen, passes forward along the upper part of the inner orbital wall to a pulley attached at the superior-internal angle at the front of the orbit; from here it is reflected backward and outward between the superior rectus and the eyeball, and is inserted into the posterior and outer part of the globe, between the superior and external recti.

The inferior oblique arises from the inner and anterior part of the floor of the orbit and passes outward and backward between the external recti and the globe, and is inserted near the superior oblique, between the superior and external rectus. The internal, superior and inferior recti and the inferior oblique are supplied by the *third nerve* (oculomotorius), the superior oblique by the *fourth* (patheticus) and the external rectus by the *sixth* (abducens).

The action of all these muscles is to turn the eye around a point, called the *centre of rotation*. These six muscles form three pairs of antagonistic muscles.

Taken singly, the muscles act to rotate the cornea as follows: The internal rectus directly inward (adduction); the external rectus directly outward (abduction); the superior rectus upward and slightly inward; the inferior rectus downward and slightly inward; the superior oblique, taking its point of action from the pulley through which it passes, turns the cornea downward and outward and rotates from above downward; the inferior oblique turns the cornea upward and outward and rotates it from below upward.

Each movement of the eye results from the combined action of certain muscles, as for example, in looking directly upward both the superior rectus and inferior oblique are brought into action. Paralysis of any one muscle will cause all movements of the eye to be less sure.

The function of the ocular muscles is to secure single vision with the two eyes by directing both eyes to the point of fixation in such a manner that the image of the object fixed shall fall simultaneously on the macula lutea of each eye. When this is done, all objects lying in the same horopter will form images upon the respective retinæ which will be equidistant from the fovea centralis and will, therefore, be appreciated as single, giving what is called binocular vision.

The *horopter* is represented by a circle which passes through the centres of rotation of each eye and through the apex of the point of fixation of the visual lines. All objects beyond or inside of the horopter will cast images on parts of the retina not equidistant from the fovea and will create the impression of two objects or double vision; for example, holding two pins in the same line, one eight

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inches and the other twenty from the eyes, on looking at the nearest pin the other is seen double, and *vice versa.* This double vision of objects not lying in the horopter causes no annoyance, because the mind ignores the impression of objects with which it does not concern itself. All objects are seen single only when retinal images fall on corresponding points of the two retinæ.

Homonymous Diplopia. If the visual line of the left eye be directed on an object and there is convergence of the right eye, the image, which would in the left eye be formed on the macula lutea, in the right would fall upon the retina to the inner side of the macula and would be projected outward to the right of the object fixed, or homonymous diplopia.

Heteronymous Diplopia. If there is divergence of the right eye at the time the visual line of the left eye is directed upon an object, the impression from the object fixed would in the right eye fall upon the retina to the outer side of the macula and when projected outward would appear to the left of the object fixed, causing crossed or heteronymous diplopia. The displacement of the false image is always in the direction opposite to that of the deviation of the eye. When the eye deviates inward, the diplopia is homonymous; when outward, heteronymous; when upward, the false image is below, and, when downward, it is above. The false image is the image of the deviating eye.

Binocular Diplopia is present when the visual axis of one eye deviates from the object of fixation.

Monocular Diplopia is due to the formation of two images of the same object upon *one* retina and exists when the other eye is closed. As in binocular diplopia there is one image cast upon each of the two retinæ the diplopia disappears on closing either eye, while if the diplopia persists on closing one eye, it is then monocular. The cause of monocular diplopia is either an anomalous refraction or a double pupil.

PARALYSIS OF OCULAR MUSCLES.—We may have one or more muscles paralyzed, and the cause may be either orbital or intra-cranial; if the latter, it may be along the course of the nerves or in the brain. Lesions of the spinal cord may cause paralysis through fibres which proceed to the brain.

Symptoms.—The characteristic indications of paralysis are, false position of the eye, limitation and irregularity in motion, and double images. As secondary effects, we find dizziness, nausea, headache, incorrect projection of the field of vision and inability to guide the hands or feet aright. If only one eye is involved the inclination is to close it. Another peculiar effect is the attitude of the head which is turned toward the paralyzed muscle to diminish the diplopia.

Causes.—The effective causes are localized periostitis, inflammation of the sheath of the nerves, basilar meningitis, hemorrhages, tumors, degeneration of nerve structure or of the cerebral nerve centres, injuries, diphtheria, rheumatism, draught of air, etc. The majority of cases of ocular paralysis occur in syphilitic subjects and are most frequently of orbital origin. Both eyes may be affected, and the cause then is intra-cranial and generally basilar. Paralysis may occur at any age and may be temporary or permanent.

Diagnosis.—In paralysis the secondary deviation is always greater than the primary, while in concomitant strabismus the primary and secondary deviations are equal. The *primary deviation* is the deviation of the affected eye when the healthy eye fixes, while the *secondary deviation* is the deviation of the good eye when the affected eye fixes. If the recovery does not occur, there follows secondary contraction of the opposing or associated muscle.

In many recent cases we can tell what muscle is affected without an analysis of the double images. The movement of the eye in the direction of action of the paralyzed muscle is less than normal, and is increased in the opposite direction; its movements are irregular and jerky. The image of the affected eye is projected—*i. e.*, seems to the patient to lie—in the direction of the paralyzed member. The inclination of the head, when present, will be such as to favor the lamed muscle and will be in its line of action.

Theoretically the examination of the double images should render the diagnosis easy and accurate, but in practice the inability of many patients to appreciate and describe the relations of the images, together with secondary contractions and involuntary compensations, make it oftentimes extremely difficult to attain an accurate chart of the double images. The double images are best detected by having one eye covered with a red glass, and the patient to describe the position and inclination of the two lights (one red and the other white) seen when looking at the flame of a candle eight or ten feet away. The images are to be noted in the different parts of the field as follows: First on the level with the patient's eyes directly in front, then to the right and left, and also at about three feet above and below this level at the centre, right and left. The use of the red glass aids the patient in detecting the two images and at the same time informs the physician to which eye each belongs. Paralysis affecting but one single muscle usually attacks either the external rectus or the superior oblique, because each of these muscles is supplied by an independent nerve. Paralysis of several muscles is usually due to the oculomotor nerve.

Ophthalmoplegia totalis is a paralysis of all the eye muscles. In this the lids droop, the eye is directed forward and immovable, pupil dilated and no power of accommodation.

Ophthalmoplegia externa, all but the pupil and accommodation affected. Is more frequent than the former and is always of central origin.

Ophthalmoplegia interna, only the pupil and accommodation affected.

Conjugate paralysis affects associated movements, as to the right or left, etc., eyes will only follow to the median line. As for example to the right, and appears as paralysis right externus and left internus. But left internus will converge in median line showing only affected in associated movements. The cause is a lesion in the association centres of the nerves.

Paralysis may result from a lesion anywhere in the course of the nerve tract (intra-cranial) it may affect the centres in the cortex of the brain (cortical paralysis), the association centers, or the nerve nuclei upon the floor of the fourth ventricle (nuclear paralysis), or the nerve trunks along the base of the skull (basal paralysis). Orbital paralyses occur from a lesion of the nerve trunk or its branches after its entrance into the orbit.

Course.—Paralysis may occur suddenly or develop insidiously. Relapses may occur, and the course is always chronic. Many cases, especially old ones, are absolutely incurable, and in even the most favorable ones six weeks or more are required for a cure. The prognosis depends mainly upon the cause. Syphilitic and rheumatic cases are the most favorable.

Treatment.—Prismatic glasses may be used for two purposes: 1. To relieve the annoying diplopia by giving that prism which neutralizes the double vision. 2. For the purpose of exercising the paralyzed muscle by using a weak prism, which nearly fuses the double images, when by the exercise of the will they may be brought together, and by using weaker and weaker prisms much improvement can be made.

Electricity is most valuable, and we should employ the constant current of from two to three milliamperes. The applications should be made daily for from three to five minutes at each sitting, with the negative pole over the insertion of the muscle and the positive at the occiput.

Forcible movements of the eye made by seizing the conjunctiva over the insertion of the paralyzed muscle with the fixation forceps, and strongly turning the eye in the direction of action of the weakened muscle, has proved of very great value in my hands. Under Cocaine this causes no pain.

As a last resort careful tenotomy of the opposing muscle may be performed, with or without advancement of the paralyzed muscle.

To overcome the annoying diplopia in hopeless cases, spectacles with a ground glass before the paralyzed eye may be employed.

Our chief reliance must be on internal medication.

Causticum.—Paralysis of the muscles resulting from exposure to cold.

Gelsemium. — Paresis from diphtheria, or associated with paralysis of the muscles of the throat.

Rhus tox.—In paralysis resulting from rheumatism or exposure to cold, wet weather and getting the feet wet.

Kali iodata.—Is more commonly indicated than any other drug in paralysis of the muscles of syphilitic origin.

Aconite, *Senega*, *Mercurius*, *Paris quad.*

PARALYSIS, EXTERNAL RECTUS.—Paralysis of the external rectus muscle causes a limitation in the outward movement of the eye. In complete paralysis the eye can be turned but little beyond the median line, while in incomplete it may often go to nearly the normal limit, but with an irregular, jerking motion. The head is turned toward the paralyzed side. The deviation of the affected eye is inward; the diplopia is homonymous; the double images are on the same level and parallel, and the distance between the images increases on looking toward the affected side.

PARALYSIS, SUPERIOR OBLIQUE.—The restriction in motion is downward and outward, and in complete paralysis of this muscle the motion downward is diminished. The deviation of the affected eye is upward and inward, and the image of the affected eye is inclined inward at the top, owing to the torsion action of this muscle on the eyeball. The obliquity of the false image is increased on looking toward the affected side. The diplopia is homonymous and present only in the lower part of the field. The image of the affected eye is lower than that of the healthy eye, and the difference in height between the two images is increased on looking downward and toward the healthy side. The image of the affected eye generally appears nearer to the patient than that of the healthy eye. The direction of the healthy eye when the diseased eye fixes, is downward and inward. The face is inclined downward and to the healthy side.

PARALYSIS, INTERNAL RECTUS.—In this, the restricted movement is inward, the affected eye is outward, the diplopia is heteronymous, the double images are parallel and of the same height, the distance between them increases on looking toward the healthy side and on looking upward. The face is turned in the direction of the affected eye.

PARALYSIS, SUPERIOR RECTUS.—The restricted motion is upward and slightly inward, the deviation of the affected eye is downward, and on looking up is downward and outward; diplopia is slightly crossed and in the upper part of the field the false image is higher than the true, its upper end is inclined to the healthy side; the difference in height between the two images increases on looking upward and the obliquity increases on looking to the healthy side. The face is directed slightly upward.

PARALYSIS, INFERIOR RECTUS.—In this we find the restricted movement is downward, the deviation of the affected eye is upward and outward, the diplopia is slightly crossed, especially in the lower part of the field; the false images are lower and inclined toward the affected side; the difference in height increases on looking downward and to the affected side, and the obliquity increases on looking toward the healthy side. The face is inclined downward and slightly toward the affected side.

PARALYSIS, INFERIOR OBLIQUE.—The restricted movement is upward and outward, the deviation of the affected eye is downward and inward, the diplopia is slightly homonymous and especially in the upper part of the field, the image of the affected eye is higher and inclined outward, the difference in height increases on looking upward and inward, and the obliquity increases on looking to the affected side. The face is directed upward and slightly toward the sound side.

COMPLETE PARALYSIS OF THE THIRD NERVE.—In this there is ptosis, slight exophthalmos, pupil moderately dilated, accommodation paralyzed; movements are restricted in all directions excepting directly outward; the deviation of the affected eye is outward; there is heteronymous diplopia, the false image is oblique and inclined toward the healthy side; it also appears higher than the true image and nearer to the patient. The distance between the images increases on looking toward the sound side, and the difference in height increases on looking upward. The face is inclined toward the sound side and slightly upward.

THE LOCALIZING VALUE OF PARALYSES OF ORBITAL MUSCLES IN CEREBRAL DISEASE.

PARALYSIS OF THE THIRD NERVE.—Ptosis may be present in cortical lesions without any other branch of the third nerve being paralyzed. Ptosis on the same side as the lesion indicates a disease of the pons; if on the opposite side, a lesion in the crus cerebri. Paralysis of the third nerve as a whole is usually present in lesions of the cerebral peduncle. Paralysis of the whole or part of the third nerve on the same side as the lesion, coming on at the same time as crossed hemiplegia, indicates a disease of the crus cerebri. The most frequent causes of oculomotor paralyses are basal lesions and usually affects all of its branches. Complete paralysis of all the branches of this nerve with no other paralysis present is always basal. Lesions in the interpeduncular space may also cause total or partial paralysis of the third nerve. Thrombosis of the cavernous sinus invariably produces paralysis of the third nerve, but all the orbital nerves and the fifth may also be affected.

PARALYSIS OF THE FOURTH NERVE alone is extremely rare, one case on record where due to tumor of the pineal gland, but is more apt to be of basal origin, and is frequently double. May occur in meningitis. It has been found with paralysis of the third in lesion of the cerebral peduncle.

PARALYSIS OF THE SIXTH NERVE when the only local sign usually results from basal disease. It is also especially liable to occur from distant pressure, and Wernicke says, particularly from a tumor of the cerebellum. Paralysis of the sixth with hemiplegia of the opposite side indicates a lesion of the pons. The facial is frequently involved with the sixth in the lesion of the pons.

PARALYSIS OF THE FIFTH NERVE with hemiplegia of the opposite side points to disease in the pons.

STRABISMUS OR SQUINT is inability to bring the visual axes of both eyes to meet at a certain point, and yet one eye will follow the other in all its movements. If the squinting eye deviates inward, it is called strabismus convergens; if outward, divergens; if upward, sursumvergens, and if downward, deorsumvergens. The squint in concomitant strabismus differs from that of paralysis in the following points: The primary and secondary deviation are equal in strabismus, while in the paralytic squint the secondary deviation is greater than the primary. In strabismus the extent of the movement in the two eyes is normal and equal, while in paralysis the mobility of the eye decreases in the direction of action of the paralyzed muscle. Diplopia is generally absent in strabismus, except at the commencement of the squint, but, when present, is found in all parts of the field; and in strabismus there is no particular inclination of the head.

Strabismus is usually *mono-lateral*, that is a faulty position of one eye; or it may be *alternating*, when the patient will be able to fixate objects with either eye separately, and when doing so the other eye becomes the squinting one. The strabismus may also be *intermittent* or *constant*. Strabismus is not observed after death, during deep sleep or in deep narcosis. Concomitant squint is very seldom accompanied by diplopia.

Binocular vision, according to von Graefe, is absent in about 90 per cent. of the cases of strabismus, that it can be produced by prisms in about 25 per cent., and exists after operation in about 50 per cent. Its presence is proven at once by the existence of binocular diplopia, and when not present it is determined by having the patient look at the flame of a candle at the distance of six or eight feet through a prism placed before one eye, when either diplopia or corrective squint will occur if the prism is not too strong, for the patient will endeavor to overcome the prism by squinting and fusing the images, or if neither of these effects occur, absence of binocular vision is proven.

The visual acuity of the squinting eye is diminished. This may exist before the development of the squint and may be one of the reasons for squinting.

CONVERGENT STRABISMUS is the most common form of squint, usually develops between the second and seventh years of life and is generally of the stationary monolateral variety. Diplopia is generally present in all cases which develop later than childhood.

Causes.—It is generally found to exist in connection with hyperopia, which is found to be present in over 75 per cent. of the cases. Hyperopia causes strabismus, because of the relation between accommodation and convergence. Hyperopes require a strong tension of accommodation for distinct vision and this effort causes increased convergence. It is usually the median or slight degrees of hyperopia that most often induces strabismus.

Differences in refraction, astigmatism, corneal opacities, etc., affecting only one eye may cause convergent strabismus.

As other predisposing causes we find constantly working in poor light, excessive use of the eyes for near work, weakened ciliary muscle and constant looking to one side.

In convergent strabismus amblyopia is usually present in the squinting eye. The amblyopia is considered by some to be a consequence of the squint and by others as the cause. Probably both views are correct, because with one poor eye the child will naturally use the best for vision and allow the other to squint; on the other hand it is easy to understand that a squinting eye will finally become amblyopic from long disuse.

DIVERGENT STRABISMUS is much less frequently seen than convergent squint and generally develops later, after childhood has passed. It is frequently in the beginning periodic, but usually becomes permanent later; it may also be alternating; generally, however, it is monolateral and concomitant. Diplopia is usually present at the commencement of the affection, especially when periodic, but gradually disappears as the condition advances. A spontaneous cure never takes place in divergent squint.

Causes.—While convergent strabismus is usually associated with hyperopia, divergence is, on the other hand, most often associated with myopia. About 65 per cent. of all cases of divergent squint are myopic. The myope requires little or no accommodation for near vision, hence impulse for convergence is too weak.

Macula of the cornea, differences in the refraction of the two eyes, or other conditions resulting in a difference in the vision of the two eyes, may also cause divergence as well as convergence, if in such a location that suppression of the indistinct image can be more readily obtained by turning the eye outward instead of inward.

SURSUMVERGENT AND DEORSUMVERGENT STRABISMUS are usually seen as a complication of lateral deviation and disappear when the lateral deviation is relieved. A concomitant vertical deviation, however, may occur alone, and, when it does, is increased, if an upward deviation, on looking inward, and if downward the squint is the greatest on looking outward. Diplopia is usually present in cases of vertical deviation.

Treatment of Strabismus.—Whenever a tendency to squint is noticed, the child should be prevented from reading, writing and all near use of the eyes as much as possible. As soon as the child is old enough to wear glasses the refractive error should be corrected. In convergent squint correcting at first as much of the hyperopia as the child will wear with comfort, later increasing the strength of the glass as fast as possible until a a full correction is reached.

In divergent squint keeping from a .50 D to a 1. D, under the full correction of the myopia.

The use of atropin to paralyze the accommodation, and thus preventing near vision, if continued for several weeks, will often greatly benefit an inclination to convergent squint. If the case is one of permanent strabismus, and an early operation is not advisable, the *good* eye should be covered for a period of thirty to sixty minutes daily and the child compelled to use the affected eye. In this way the vision of the squinting eye will be retained. The fact must also be borne in mind in the treatment of convergent squint that there is a tendency in some cases to a gradual disappearance of the squint as the child grows older, and, when this does occur, it is usually not earlier than the tenth year and often much later. Therefore it is not advisable to operate, except in high degrees of squint, and then only a partial correction until about the tenth year.

The use of remedies has in the early stages of some cases relieved the tendency to permanent strabismus.

Cicuta vir.—In convergent strabismus occurring in children, particularly if spasmodic in nature, or caused from convulsions, to which the child is subject.

Jaborandi.—Convergent strabismus, periodic and resulting from spasm of the internal recti.

If helminthiasis has been the cause, *Cina*, *Cyclamen* or *Spigelia* may be required. If due to spasms, convulsions, or any intracranial disorders, *Agar.*, *Bell.*, *Eserine*, *Gels.*, *Hyos.*, *Nux* or *Stram.* would be first suggested to our minds.

Orthoptic exercises if faithfully and persistently carried out are of service in the moderate degrees of squint. The child must first be taught to recognize images with each eye simultaneously and then to fuse the two images by approximating the two pictures toward each other. The stereoscope and pictures suggested by Kroll are the best for this purpose. Worth's amblyoscope is also a valuable instrument for this purpose.

Operative Treatment for strabismus may be by either tenotomy of the contracted muscle, advancement of the weak or opposing muscle, or by both combined. As to the time when the operation should be made, my preference is to wait until the child is about ten years of age, unless it is a very pronounced permanent squint, when a tenotomy, aiming to correct only a portion of the squint, may be made at a much earlier age.

A free tenotomy of one muscle corrects a convergent squint of three or four millimetres, but in divergent squint not more than two millimetres. As the effect of the operation in divergent squint decreases afterwards, the attempt should be made to get an over-correction. To correct a divergence it is usually necessary to make the tenotomy in both eyes and often an advancement is also needed.

As to the advisability of operating on one or both eyes at the same sitting, authorities seem to be about equally divided. It is, however, always my rule to operate upon but one eye at a time, taking at first the eye with the greatest deviation and making a free division of the muscle, and a few weeks later making a second operation upon the other eye, if needed. Previous to operating we should determine the cause of the squint, the vision, the relative power of the muscles, and the degree of the deviation in each eye. The *technique* of the operation is the same, irrespective of the muscle operated upon.

The result to be obtained from the operation is merely cosmetic, as the vision in the squinting eye is not improved and binocular vision is only restored in a few instances.

Tenotomy of the Internal Rectus.—As this operation is quite painful, an anesthetic should be used. Four to six instillations of a 4 per cent. solution of cocaine at intervals of about five minutes renders the operation painless, and is to be preferred to a general anesthetic because we are better able to judge of the effect accomplished. In young or excessively nervous subjects, ether or chloroform may have to be used. The instruments required are a speculum, fixation forceps, curved scissors and strabismus hook. The lids should be widely separated by the speculum; the conjunctiva and subconjunctival tissue directly over the insertion of the muscle to be divided is seized with the fixation forceps, and with a pair of curved, blunt-pointed scissors, make a vertical cut down to the muscle, which is then separated from the subconjunctival tissue by dissecting backward with the scissors as far as it is desired to have the muscle slide for its re-attachment. The strabismus hook is now to be introduced behind the muscle at its lower edge, and, with the point pressed against the eyeball, turned upward beneath the tendon, which is then to be divided close to its insertion by cutting from the point to the heel of the hook. The hook should then be inserted again to see if all the lateral expansions of the tendon have been divided. The sinking of the caruncle is the result of a too free dissection of Tenon's capsule.

The use of the suture to limit the effect of the operation, if too extensive, may be necessary. Diplopia, with the images near together, for two or three days after the operation, is not unfavorable, as it is usually due to the inflammatory action and disappears as the inflammation subsides.

The effect of an operation for convergent squint may be increased, if desired, by a free division of Tenon's capsule both above and below the muscle, or by a strong suture passed through a fold of the conjunctiva at the outer side near to the cornea, and then carried through the skin at the external canthus, one end above and the other below, about one-eighth of an inch apart, and then tied; or they may be fastened to the skin by strapping. The eye is thus held in the proper position for two days, when the muscle should have become re-attached and the suture removed.

Subconjunctival Tenotomy is preferred by some to the operation just described. This is made by snipping the conjunctiva along the lower edge of the insertion of the

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muscle with blunt straight scissors. The subconjunctival tissues are then separated over the muscle and the strabismus hook inserted, catching up the muscle on the hook. The scissors are now introduced, one blade in front and the other behind the muscle, which is held on the stretch by the hook, and it is divided subconjunctivally.

Advancement of the Muscle is designed to increase the power of a muscle by shortening it. This operation is useful in cases of extreme convergence and especially in those cases where the operation for convergent strabismus has resulted in a deviation in the opposite direction, and hence the internal rectus is the muscle most frequently advanced. A tenotomy of the opposing muscle is usually necessary and is generally made at the same time.

In advancement of the internal rectus the conjunctiva over the tendon is divided as for tenotomy. The conjunctiva between the cornea and the opening is separated from the sclerotic with the scissors. The tendon is then caught upon the hook and held by an assistant. A suture is next introduced from the upper margin between the tendon and the sclerotic, and passed through the tendon at the median line some distance back of its insertion. Another suture is passed through the tendon from below in the same way. Each suture is then firmly tied on the tendon, a long end being left to each. The tendon is now to be divided at its insertion, and the sutures passed forward under the conjunctival flap, the upper to the upper margin of the cornea and the lower to the lower margin. The sutures are then tied separately; the tighter they are drawn the further is the tendon advanced.

The After-Treatment.—Simple tenotomy creates no serious reaction, and the patients are allowed to return to their homes and to use their eyes as much as is desired. The use of small pads of absorbent cotton removed from a large piece of ice and applied to the eye and changed every one or two minutes gives great relief to the soreness experienced for the first day. The advancement of a muscle is accompanied by considerable pain and swelling, which is usually controlled by keeping the patient in bed with both eyes bandaged, the ice-bag applied locally and *Aconite* given internally.

NYSTAGMUS (*Oscillation of the Eyeballs*).—These movements are involuntary, exceedingly rapid, almost rhythmical, and affect both eyes at the same time. The mobility of the eye is not otherwise impaired. The oscillation is generally in the horizontal direction, but may be rotary, vertical, or in the direction of a single muscle. It is usually permanent, but may be periodic and in some positions of the eye may have a point of rest. Nystagmus is increased in near vision and from excitement; in some cases it is complicated by similar movements of the head, but in an opposite direction. The sight is always impaired, but objects are seen as they are by the patient. Nystagmus is not infrequently associated with squint.

Miners' Nystagmus is that form found in those working in the darkness of the mines and in unnatural positions. This variety causes an apparent movement of objects observed and often results in vertigo.

Causes.—Occurs in childhood and is the result of amblyopia, as in congenital opacities of the cornea, congenital cataract, or total blindness. Nystagmus may be a symptom of cerebral disease, especially disseminated sclerosis.

Treatment.—If there is any anomaly of refraction, it must be corrected with glasses.

Agaricus.—Twitchings of the eyelids. The spasmodic movements are absent during sleep, but return on waking.

Hyoscyamus and *Ignatia.*

HETEROPHORIA.—Insufficiency of the ocular muscles exists when there is a *tendency* of the visual axes to deviate from parallelism.

The word tendency is used to describe this condition because it is but very rarely that it appears as an actual deviation or squint. Once in a while in a high degree of heterophoria, if the patient becomes very tired or nervous, or from some cause the stimulus for binocular single vision is removed, there will be a slight deviation with diplopia. Heterophoria is often called latent strabismus, as the two conditions only differ in degree, but as we believe it rarely if ever leads to a true concomitant squint, prefer the term suggested by Stevens of heterophoria.

Causes.—Refractive errors, owing to the relation between accommodation and convergence, undoubtedly play a very important part in bringing on this condition. Weakness of the muscles may be found congenitally or following disease. Many patients attribute the eye trouble to La Grippe and it is then probably due to overuse of the eyes when all the muscular system is greatly lowered. During convalescence from fevers or other exhaustive diseases, patients are frequently allowed to use for hours the extremely delicate eye muscles in reading, etc., long before they are permitted to even walk across the room.

Overuse of the eyes at the near point, in poor light and in faulty positions of the head causes many cases.

Varieties.—The following terms suggested by Stevens are now generally used:

Orthophoria, a tendency of the visual axes to parallelism.

Heterophoria, a tendency of the visual axes from parallelism.

Esophoria, a tendency of the visual axes to converge.

Exophoria, a tendency of the visual axes to diverge.

Hyperphoria, a tendency of the visual axis to deviate upward. The designation, right or left, is applied to hyperphoria according to which eye tends to deviate upward.

Hyperexophoria and *hyperesophoria* are applied to a combination of exophoria or esophoria with hyperphoria.

Diagnosis.—*The Maddox Rod Test* is preferred for the distant examination. This consists of a short piece of a glass rod mounted in a metallic rim and placed in the trial frames. The rod is placed horizontally in front of the right eye, while the patient looks at a lighted candle six metres distant he will see the normal light and a perpendicular line of light passing directly through the flame if there be orthophoria of the lateral muscles. If, however, the streak of light passes to the right of the flame it denotes esophoria, and if to the left, exophoria. The degree of the deviation is shown by the prism placed before the left eye, base out for esophoria and base in for exophoria, which brings the streak of light into the flame.

The rod is now turned to the vertical position and the streak of light runs horizontally, either above or below the flame if hyperphoria is present.

The Prism Test is made by placing a prism of 7 or 8 degree base down before the right eye which causes diplopia, one image directly over the other in normal eyes. If the upper image is to the right, esophoria is present, if to the left, exophoria, and the degree is measured by the prism that brings the upper image directly over the lower. Hyperphoria is determined by an 8 or 10 degree prism base toward the nose in front of the right eye.

This test is the most reliable in determining the condition of the muscles during the act of accommodation, and as employed by Von Graefe consisted of a prism of 10 or 15 degree base down before the right eye while a card having upon it a large dot through which a fine line is drawn is held vertically 33 m. from the eyes. There should appear two dots on one line and if not on the same line the prism that makes them so denotes the degree of the deviation.

The examination of the muscular balance during accommodation is most important and too often ignored.

Stevens's Phorometer is an instrument devised for making the prism tests.

The Harold Wilson Phorometer combines both the Maddox rod and the prism test and also the Savage test for the oblique muscles. There are a number of other instruments made for testing the muscle balance, but the Wilson Phorometer is preferred by the writer.

The Cover Test made by having the patient fix a light, six meters distant, and by quickly covering first one eye then the other and noting if the uncovered eye deviates either inward or outward, denoting esophoria or exophoria, is a crude test showing the higher degrees of trouble.

The Fixation Test also shows in a general way the balance of the muscles in accommodation. This is made by approaching the finger toward the patient's eyes, which should be both fixed constantly on the finger, and if one eye deviates outward before the finger reaches three and one-half inches from the eyes, exophoria is present.

HYPERPHORIA.—A tendency of one eye to rise above the level of its fellow is apt to cause far greater disturbance relatively than the other varieties of heterophoria, owing to the inability of the muscles to maintain the two eyes on the same horizontal plane. Hyperphoria may be often diagnosed by the head being carried toward the shoulder. As a result of hyperphoria we may have neuralgia, headache, persistent nausea, pain in the back, vertigo, neurasthenia and other reflex disturbances.

The normal power of the muscles that raise and lower the eyes is much less than the muscles that turn the eyes on the horizontal plane. The normal power to overcome prisms base up or down varies from 3° to 8°.

ESOPHORIA.—A tendency to convergence is frequently found at the distant point and an exophoria in accommodation; in such cases the presence of hyperphoria should be suspected.

Some writers have claimed a much higher proportion of cases of esophoria than exophoria Stevens at one time claiming a proportion of more than three to one; later these figures were very greatly modified.

The writer's experience, however, shows a much larger proportion of exophoria. The difference is probably due to the fact that many oculists have in the past, and some perhaps still, base their examination of the muscular balance at the distance only. This we have claimed to be a great error, as the large majority complain of their eyes when using them at near work. It is therefore of the utmost importance in our judgment to carefully examine the muscular balance in accommodation. In those cases showing esophoria at a distance and exophoria in accommodation the diagnosis should be based upon the point at which the eyes feel strained. If the discomfort is altogether upon using the eyes at near work the diagnosis should be exophoria. On the contrary, if the discomfort is while riding, visiting picture galleries, etc., the case should then be called esophoria.

Symptoms.—The disturbing effects from esophoria are more obscure and remote than exophoria. The patient is apt to complain of occipital headaches, pain down the spine, nausea, vertigo, a general sense of illness, etc., especially after an attendance at church or theatre, after riding or walking or any use of the eyes at distant objects.

In esophoria we often find the power of accommodation low, some dilatation of the pupil, and they may complain of seeing their nose or a black spot before the eyes. Esophoria is often accompanied by some amblyopia and is almost invariably of a higher degree when examined under atropin.

The normal power of the external recti in overcoming prisms base in should be from 10° to 14°, yet a much lower degree may be present in orthophoria, or a very much higher degree may be found and still esophoria be present.

EXOPHORIA.—A tendency of the eyes to diverge from insufficiency of the internal recti is the most common form of muscular disturbance and is due to the over-use of the eyes at the near point.

Symptoms.—In exophoria the symptoms are always present and attributable to the use of the eyes at near work. The eyes feel tired and strained upon a few minutes reading, the letters blur and run together, the patient stops reading to rest the eyes, rubs and presses them. He resumes reading again, but the tired and strained sensations return and grow worse the longer the eyes are used and headaches come on. Headaches are especially frontal, but may affect any part of the head.

The power of the internal recti in overcoming prisms is much greater than any of the other muscles. We have been in the habit of considering about 70° as the normal point, for the large majority of cases will reach this point after a short course of prism exercise before the exophoria will be corrected, and we have seen many cases where a power of 80° would be reached and still exophoria be present. On the other hand, a power of 20° to 40° in some cases will be sufficient to give orthophoria.

Treatment of Heterophoria.—First, do not attempt to correct all cases of heterophoria as some are far better left alone. We have frequently seen cases, sometimes of a very high degree of trouble, where there have been, so far as the patient knew or we could detect, absolutely no signs of disturbance traceable to the eyes. In these cases it is a good rule to let well enough alone. Again, we have seen a number of cases where an effort had been made to correct by operation or otherwise, and in some instances successfully, an heterophoria which had apparently never caused any trouble, and which had resulted in causing great discomfort thereafter.

On the other hand, we have seen over and over again most surprising results from the correction of even the slightest shade of heterophoria. In fact there has proved to be nothing in the range of ophthalmology that has given greater benefit and happiness to the patient than the careful correction of some form of heterophoria. Headaches, neuralgias, chorea, epilepsy, and many other forms of reflex nervous disturbances, have been so frequently promptly and permanently cured that there remains no room for doubt as to the possibility of a slight loss in the muscular equilibrium of the eyes being the cause. Yet we must caution against the tendency of the enthusiast to attribute all ills that flesh is heir to to heterophoria.

You should first carefully test and record the degree of heterophoria, both at the distance of 6 metres and in accommodation at 33 cm. *Tested with*, as well as without, *the glasses the patient is to wear*. You should then examine and record the power of the various muscles to overcome prisms. Having then taken into consideration the symptoms of the patient and finally determined which muscles are at fault, the treatment can then be scientifically followed out.

The first consideration is then to be paid to any refractive errors that may be present and which may have been the primary cause of the trouble. The refractive error must be carefully corrected, always bearing in mind the effect of lenses upon the muscular balance. The most important fact in this connection is, *that convex lenses always increase exophoria and decrease esophoria*, and *vice* *versa* concave lenses decrease exophoria and increase esophoria.

In the final adjustment of the glasses ordered for the patient be particular to see that they are accurately centered, as in the stronger glasses a slight inaccuracy in this respect may cause a heterophoria.

Prism exercise should be undertaken to develop and strengthen the weakened muscle. In hyperphoria and esophoria the results are less satisfactory and slower of attainment as the muscles involved are normally of much less power and are not as much under the control of the will as in exophoria. In these cases my custom has been to give the patient prisms of sufficient degree to cause slight diplopia with images near together, set in spectacle frames to be worn daily for ten to twenty minutes after objects in the room and at greater distance have been fused.

In hyperphoria the base of the prism is set up in one eye and down in the other, while in esophoria they are to be set base in before each eye. The strength of the prisms are of course to be increased as the power of the muscles to fuse the images increases.

In exophoria we can usually attain most brilliant results in from four to eight weeks of prism exercise when thoroughly and carefully followed out three times a week. My method is by holding prisms base out before one eye at a time while the patient looks at a lighted candle six metres away, until the double images are fused, increase the strength of the prism each time until at each sitting they are unable longer to fuse. Efforts should be made to secure a quick action of the muscles, the majority will draw the lights together almost instantaneously, the prism is then held for a few seconds and replaced by a stronger one.

Frequently we find patients who at first can only overcome a 10° prism or even less. In these cases for the first few treatments each change of prism is to one but 1° or 2° stronger and we may succeed in making a gain for the day of only 2° to 4°. At each following treatment they should be worked up to a higher degree than they accomplished at the previous sitting. Always commence each sitting with prisms much lower than the limit of the preceding treatment. For example my practice would be, in patients having power to overcome from 50° to 60° prisms, to commence with a 20° prism, jump to a 30°, then 34°, 38° and from there on but 2° higher at each change. Some of these numbers are held before the eye for several seconds, others will be quickly removed when fused and immediately replaced, having the patient fuse the same prism several times. After reaching the limit they can fuse, the other eye is gone through with in exactly the same way. Frequently the operation is repeated the second or in some cases the third time before each eye.

Over-exercise has frequently caused disagreeable results in the way of vertigo, faintness, nausea and even vomiting, and while under-exercise will not yield the desired results, and as no two cases are the same, this treatment should not be entrusted to the patient. Regularity in the treatments, three times a week, should be insisted upon. More frequent treatments may overdo, and from less frequent they will not gain as well. There are many little points in following out this method which are acquired by experience, and which prove most valuable in difficult cases. The majority of cases respond promptly and nicely to the treatment, others require a great deal of time and patience before they get into the knack, while rarely we have to confess inability to do anything with them.

Correcting Prisms.—The use of prisms to correct heterophoria may be likened to ordering crutches for a lame person. In prescribing prisms for this purpose it is better, as a rule, not to put on the full correction, and should only be ordered after prism exercise has been carried to its fullest extent without relief. Prisms may be combined with the glass correcting the refractive error or worn alone. The base of the prism should be toward the nose in exophoria, out in esophoria, and either up or down in hyperphoria.

About one-half of the actual deviation should be corrected, if this does not require too heavy a prism, and it is best to divide the amount of the correction between the two eyes. The prism effect may be obtained by decentering the lenses required for the refractive error, if the latter is of a high degree.

Operative measures should only be resorted to after all other methods have failed to give relief. These consist of either a partial or complete tenotomy, and of advancement or shortening a muscle. The operations of complete tenotomy and of advancement have been described under strabismus.

The partial tenotomy is made by making a small opening in the conjunctiva over the insertion of the muscle; the centre of the tendon is then seized with the forceps just back of its insertion and divided. The Stevens hook is now inserted through this opening in the centre of the tendon, the remaining fibres picked up and carefully divided until the desired effect is acquired.

The extent of the operation is regulated by frequent examinations with the phorometer. If found to be too extensive, it may be limited by a very fine suture.

Electricity in all its forms has been used with decided value in the treatment of heterophoria. The faradic, galvanic, static, and high frequency currents have all been successively employed by the writer, the latter giving the most satisfactory results of all.

The following remedies have been especially of service:

Ruta grav.—Aching in and over the eyes. The eyes feel hot, tired and strained.

Gelsemium.—Soreness and tired feeling of the eyes on using. Asthenopia from esophoria.

Onosmodium.—Heaviness and dulness of the eyes. Pains in the left side of the head. General muscular prostration.

Senega.—Dulness of head, with pressure and weakness of eyes.

Natrum mur., *Sepia*, *Conium* and *Spigelia.*

CHAPTER IX.

DISEASES OF THE CONJUNCTIVA.

Anatomy.—The conjunctiva is the delicate mucous membrane lining the inner surface of the eyelids; from the lids it is reflected upon the globe and covers the sclerotic as far as the cornea, with which it becomes continuous. The conjunctiva is divided into three portions: the *palpebral*, covering the inner surface of the lids; the *bulbar*, covering the sclerotic; and the *fornix*, or loose folded portion connecting these two. At the cornea the conjunctiva overlaps the cornea slightly, and at this point is called the conjunctival or corneal *limbus*. The bulbous portion of the conjunctiva is formed of three layers—the external epithelial layer, the fibrous tissue and the subconjunctival tissue.

The epithelial layer is formed of cylindrical cells externally and a deeper layer of smaller cells. The fibrous tissue is a fine reticulated structure, containing nucleated cells, together with a few elastic elements. The subconjunctival tissue is loose and elastic, with fibres uniting it to the sclerotic. The conjunctiva, especially the portion covering the lid and forming the cul-de-sac, contains numerous lymphatic follicles and acinous glands.

The nerve supply of the conjunctiva is very free and is derived from the fifth pair. The blood supply is also extremely abundant, especially in the region of the limbus and around the caruncle.

The function of the conjunctiva is to act as a lubricating surface.

HYPEREMIA OF THE CONJUNCTIVA.

Symptoms.—There is a moderate injection of the blood-vessels, especially of the palpebral conjunctiva, which have the appearance of a coarse network. The eyes are slightly red, feel hot and heavy, and as though there was sand in them; there is a smarting, itching and a tired feeling on using them, or from exposure to a bright light.

Causes.—The most frequent cause is a prolonged effort of the accommodation in those who have some uncorrected error of refraction; from exposure to severe cold or heat, or from foreign bodies. Often seen in those living or working in a vitiated atmosphere. It is also frequently associated with nasal catarrh, hay fever, etc.

Course.—It may be either acute or chronic, and when chronic it may cause a blepharitis, or become a catarrhal conjunctivitis.

Treatment.—See *Catarrhal conjunctivitis.*

CATARRHAL CONJUNCTIVITIS is a hyperemia of the conjunctiva plus a discharge from the membrane—a simple hypersecretion.

Symptoms.—These are the same as found in hyperemia, but of a higher degree; the itching, smarting and burning sensations, the photophobia, lachrymation and redness of the eye are all present, and, from the greater inflammation and infiltration, we have chemosis. The discharge from the eye may be more or less excessive, but of a bland or muco-purulent character. The amount of secretion varies, and at night is apt to accumulate and cause crusts on the cilia.

Course.—An acute attack does not usually last more than from one to three weeks, but if neglected may become chronic.

Cause.—It may appear as an extension of a nasal catarrh, from an affection of the eyelids, or from an inflammation of the lachrymal sac. Exposure to cold, dust or smoke, confinement in a close or vitiated atmosphere; often due to refractive errors, and is apt to occur with the exanthemata.

Diagnosis. — As other diseases of the eye may very closely resemble a conjunctivitis, the differential diagnostic points should be considered. The principal diseases usually mistaken for conjunctivitis are iritis, episcleritis and keratitis.

Differential Diagnosis.

Conjunctivitis.	Iritis.	Episcleritis.	Keratitis.
The redness of the conjunctiva is general, and on pressure through the lower lid the injected vessels are seen to move with the membrane over the sclerotic. There is always redness of the fornix conjunctiva, and usually of the palpebral conjunctiva. There is a muco-purulent discharge, more or less profuse. The iris is clear and bright, the pupil reacts readily to light and the cornea is clear.	The redness is deep-seated, surrounds the cornea as a rosy zone, and is not accompanied by redness of the fornix or palpebral conjunctiva. The injected vessels are beneath the conjunctiva, and do not move with it. The iris is discolored, pupil sluggish and inactive and the vision is impaired. There is usually very severe pain in the eye and head, which is generally worse at night.	The redness is of a dusky-red color, is subconjunctival and localized; it is most often situated over the external rectus muscle, or over the internal. There is usually little or no pain, and the duration of the disease is much longer.	The redness is deep-seated, and usually most marked around the cornea. The transparency of the cornea is always more or less diminished. The photophobia is more intense and the lachrymation more profuse. The vision may be greatly impaired.

Treatment.—The first point in the treatment should be the removal of a foreign body or any other exciting cause.

Correct any existing refractive error; stop any over-use of the eyes and protect them from exposure to wind, dust and bright light.

Cleanliness is always essential and the local use of ice has proven most beneficial. Ice should be used *constantly* for at least twenty-four to forty-eight hours and is best applied by means of little pads of absorbent cotton, a number of them laid on a large block of ice and when cold to the eye. These pads must be changed every one or two minutes. For local use boric acid (gr. x, ℥i), bichloride of mercury (1:4000), protargol (4 per cent.), argyrol (10 per cent.). In slight or chronic cases the following prescription has been of service:

℞. Soda biboratis, ... ℈j.
Aqua camphoratæ, ... ℥iij.
Misce.

Instil a few drops in the eye four times a day.

The attendants should be warned that the discharge is contagious, and that the sponges, towels, etc., used upon the patient should not be employed for any other purpose.

The administration of the internal remedy is, as a rule, all that is necessary in this disease. In the following list of remedies will be found those most frequently indicated. For special indications see *Remedies in Conjunctivitis*, page 150. *Acon.*, *Pulsat.*, *Euphras.*, *Apis*, *Rhus*, *Sulph.*, *Arsen.*, *Merc.*, *Hepar*, *Graph.*

EPIDEMIC CONJUNCTIVITIS (*Pink Eye*).—An acute catarrhal conjunctivitis, but entitled to a distinct classification because decidedly contagious and epidemic in its character.

Symptoms.—Those of catarrhal conjunctivitis, but more severe and more rapid in their onset. It commences as a burning sensation and as of something in the eye, followed by a rather free lachrymation, soon becoming mucoid in character. Within one or two days there is a swelling of the conjunctiva, puffiness of the lids and a rather profuse muco-purulent discharge. The lids are agglutinated in the morning, and the discharge becomes somewhat stringy in character, with occasionally the formation of a false membrane on the conjunctiva.

The disease usually runs its course in about two weeks, but may often be cut short by prompt treatment at the start.

Causes.—Koch and Weeks, working independently, discovered a small bacillus in this condition, which reproduced a similar disease when inoculated in a normal conjunctiva. The disease is generally communicated through the secretion from some affected eye.

Treatment.—Cold compresses, cleanliness and the indicated remedy will usually control these cases in a few days. *Acon.*, *Puls.*, *Euphras.*, *Rhus*, *Apis* and *Kali bich.* will cover many cases.

Local applications are, as a rule, not needed in the milder cases.

A solution of Adrenalin, 1 to 2,000, instilled every hour or oftener reduces the degree of inflammation and shortens the attack.

If, however, the discharge seems quite excessive, Argyrol 5 per cent., or the following prescription instilled into the eyes four times a day seems to exert a beneficial influence:

℞. Zinci sulph., ... gr. ij.
Sodii chlorid., ... gr. iv.
Aqua dest., ... ℥i.
Misce.

PURULENT CONJUNCTIVITIS (*Ophthalmia Neonatorum, Gonorrheal Conjunctivitis*). An acute inflammation of the conjunctiva with a purulent discharge may occur at any time of life, and bears essentially the same features, whether occurring in the infant soon after birth, or in the adult as a result of infection from a gonorrheal or other discharge. They are practically the same, however, and will be generally described under the one heading.

Pathology.—The conjunctiva becomes infiltrated with serum, with a proliferation of cells and lymphoid elements; the blood-vessels become dilated, the capillaries increased in number and there is also some thickening of the epithelium. The contagiousness of this disease is due to micro-organisms, the gonococci of Neisser, which are found in the pus secreted by the conjunctiva and also in the superficial layers of the conjunctiva itself.

Symptoms. -All those of catarrhal conjunctivitis are present in a much higher degree. The most prominent symptom is chemosis, which may be sufficient to overlap the cornea. The edema of the lids is so great as to cause ptosis. The papilla of the conjunctiva are elevated and form villi, which bleed easily and give a thick, swollen appearance to the conjunctiva of the lids. Another most prominent symptom is the discharge, which at first is thin, muco-purulent, but soon becomes distinctly purulent, a thick yellow secretion, and is so excessive that the eye and cheek become literally bathed in pus.

At first there is a feeling of heat, smarting and burning pains in the eye, then ciliary pains and shooting pains in the head set in. In some there is a distinct febrile movement. The swelling of the lid becomes hard and tense, making it difficult for even the physician to open them, and of a dusky red color—the upper lid overhanging the lower.

The first stage, or *stage of infiltration*, lasts from two to four days, in which the disease has reached its height. The second stage, or that of *pyorrhea* succeeds, in which the swelling of the lids and the tense infiltration of the conjunctiva decreases. With this there begins a profuse secretion of pus, which gradually lessens as the swelling subsides, and the mucons membrane finally returns to a normal condition in from four to six weeks.

The great danger is an involvement of the cornea, which may lead to ulceration and even slough of the entire cornea. The cause of this participation of the cornea is due to either direct action of the infectious matter on the cornea; to direct continuity of inflammation to the substance of the cornea; or to the stoppage of the nutrition of the cornea by the chemosis.

Causes.—There may be two varieties of purulent conjunctivitis; the first, and most serious, due to the gonococcus of Neisser; the second, or non-specific variety, is due to inoculation of the conjunctiva with muco-purulent discharge other than gonorrheal. Contagion is undoubtedly the direct cause in every case and the disease breaks out in from a few hours to three days after infection. In infants it usually results from a leucorrheal or gonorrheal discharge at the time of birth. In adults the infection is introduced from the genitals, by touching the eyes with unclean fingers and is more often the result of infection from gonorrhea. Girls have been affected from an ordinary leucorrheal discharge. Secretions from a diphtheritic conjunctivitis, or an altered or decomposed discharge from a catarrhal conjunctivitis may cause a purulent ophthalmia.

Prognosis is always serious if the cornea is affected, as permanent opacities, staphyloma of the cornea, or even complete destruction of the eye may ensue. Even when the cornea is not affected, do not give a too favorable prognosis, as corneal complications may arise at any time.

OPHTHALMIA NEONATORUM.—The ophthalmia of the newly-born child is undoubtedly the result of inoculation from a leucorrheal or gonorrheal discharge and occurs during birth, or later from the soiled linen or sponges. When contracted during labor it is only in cases where the eyes are prematurely opened and it manifests itself from the second to fourth day after birth. When resulting from soiled linen, etc., it is usually later in presenting its appearance, and, when beginning later than the first week, is almost certainly due to some extraneous source of inoculation. The symptoms are those just described under purulent conjunctivitis, and are generally less severe than under gonorrheal. The prognosis is therefore more favorable, because with less swelling there is less danger of corneal ulceration.

Statistics have shown that in former years from 20 to 79 per cent. of all cases of blindness have resulted from this disease. In late years the attention that has been paid to the prevention of this disease has very materially lowered the per cent. Still we are daily meeting cases of permanent blindness from this disease which should be attributed wholly to the ignorance of those attending these cases. Much of this fatality could be obviated by careful disinfection of the vagina at the time of parturition and in cleanliness in the linen and the sponges used and the hands of those coming in contact with the child or mother. In *all* cases of gonorrheal or leucorrheal discharge in the mother, the method recommended by Credé should *always* be employed. This consists in carefully cleansing the child's eyes with clean water and then the instillation between the eyelids of a drop of the 2 per cent. solution of Nitrate of Silver, (gr. x. ad. ℥i).

GONORRHEAL CONJUNCTIVITIS.—This disease is always due to infection. Its onset is often accompanied by a severe arthritis. The inflammatory process is usually very intense and runs a rapid course. The lids are greatly swollen, as is also the palpebral conjunctiva. There is excessive chemosis and purulent secretion.

The disease usually develops in about forty-eight hours; it may occur in either acute or chronic gonorrhea.

The right eye is more often first affected, and it is more frequently found in males than in females. The physician must always handle all cases of purulent conjunctivitis with extreme care, on account of possible infection. This variety of purulent conjunctivitis is more severe than when due to any other cause, as about one-half of all eyes attacked with this disease are lost, while hardly one-third of the other forms of purulent conjunctivitis are fatal.

Treatment *of Purulent Conjunctivitis.*—If the attack is very severe, the patient should be confined in bed; if only one eye is affected, the other should be hermetically closed in order to prevent any of the matter coming in contact with that eye. The healthy eye is best protected by means of a watch-crystal held in place over the eye by strips of adhesive plaster. In this way the eye is hermetically sealed, can be used for vision, and is always under observation. Great care must be taken to make no pressure upon the eye in opening it, on account of the danger, if ulceration be present, of causing rupture of the cornea and escape of the lens. There is also danger of some of the purulent secretion spurting into the eye of the surgeon. Owing to the contagiousness of the secretions great care should be exercised both by the nurse and physician, to protect their own eyes and those of others, by providing that the sponges, towels, etc., are used only by the patient; also, that their hands are thoroughly cleansed before touching another eye. If, by accident, any of the discharge should have entered a healthy eye, lukewarm water should be at once injected under the lids to wash it away; after which, drop in a strong solution of chlorine water, or a weak solution of Nitrate of Silver (gr. ij. ad. ℥j). The special and primary point to be attended to in the treatment is *cleanliness*. The eye should be thoroughly flushed out with water every five to fifteen minutes in severe cases. Solutions of the peroxide of hydrogen, or chlorine, may be used for this purpose.

In the early stage of purulent conjunctivitis *ice compresses* will be found most valuable. Ice bags may be used on the eye, or if the weight is complained of, cold may be applied by means of little pledgets of absorbent cotton laid upon a large cake of ice; these pads are to be conveyed quickly from the ice to the eye and changed every one or two minutes so that the cold will be constant.

A two per cent. solution of the Nitrate of Silver applied once or twice a day is preferable to stronger solutions, and even much weaker solutions have given good results. We have formerly believed that Nitrate of Silver, thirty grains to the ounce, would abort some cases in one application if applied shortly after inoculation, but recent investigations have seemed to dispute this.

The new Silver preparations have proven in our hands of more benefit of late and may be used, the Protargol from 20 to 50 grains to the ounce, and Argyrol in double this strength.

Scarification is sometimes needed. The incisions are not to be made deep, but long and parallel to each other, and may be repeated every twenty-four hours, if needed; promote the bleeding by warm water and by kneading the lid.

Aqua chlorinii, as an external application, has proved a very valuable remedy in the various forms of *purulent* ophthalmia.

Canthoplasty is frequently made, if the lids are much swollen and very tense, to relieve the pressure upon the eyeball and to permit of more thorough opening of the lids for the purpose of cleansing.

When the cornea becomes ulcerated some operative measure, paracentesis, or Sæmisch's incision, or the use of Atropin or Eserin, may be required, according to the complication.

The most important remedies in this disease are *Argent. nit.*, *Hepar*, *Mercurius*, *Rhus tox.*, *Calc. hypophos.*, *Acon.*, *Apis*. For indications see *Remedies in Conjunctivitis*.

DIPHTHERITIC CONJUNCTIVITIS is perhaps one of the worst diseases of the eye we have to deal with. It is a purulent inflammation, that spreads by infection and the secretion of which is contagious. It may exist alone or with diphtheria of the throat.

Pathology.—It is a fibrinous infiltration throughout the entire thickness of the mucous membrane, which seriously interferes with the circulation.

Symptoms.—It commences with acute pain, a feeling of heat and lachrymation. The upper lid becomes very much swollen and sometimes of such a board-like hardness that it is impossible to evert it. The skin of the lid is smooth, shining, and of a pale, rosy or livid hue. On everting the upper lid we find it smooth and yellowish; upon removing a portion of the thickened membrane we find that it has the same appearance all through, due to the infiltration. The whole lid has a lardaceous appearance in the most severe cases, while in the cases of partial diphtheria we will notice one or two smooth, depressed places of a grayish-yellow color where the exudate is excessive. The conjunctiva between these islands is swollen, red and bleeds easily. The secretion is sanious and contains flakes of diphtheritic matter.

The disease so far has been one of infiltration, lasting from one to ten days, and is the most dangerous stage, on account of corneal complications from the shutting off of its nutrition. Then begins the second stage, that of purulent discharge. The lids lose their hardness and there is set up a copious discharge of fibrinous masses. The vessels reappear at points and the infiltration looks like white patches here and there. The chemosis loses its yellow appearance and stiffness, and the whole disease now looks like an ordinary attack of purulent conjunctivitis. Instead of ending here, it enters a stage of cicatrization, which results in more or less adhesions between the lid and eyeball.

Causes.—Contagion is the principal cause. Diphtheritic affections of other parts may be present at the same time, and we may have the general symptoms of fever, exacerbations, weakness, loss of appetite, etc.

Prognosis is always serious. There is not only the probability of the loss of vision, but in addition the danger of loss of life.

Treatment.—See *Croupous Conjunctivitis.*

CROUPOUS CONJUNCTIVITIS (*Membranous Conjunctivitis*).—This disease is characterized by an exudate on the surface of the tissue, especially the cul-de-sacs, where it hardens into a membrane, while in diphtheria the exudate is within the tissue itself. The membrane may be peeled off and leaves a bleeding surface. The lids, while red and swollen, are soft. The upper lid hangs down over the lower. There is at first a watery secretion mixed with mucus, which later becomes more purulent. The membrane is similar microscopically to that of tracheal croup. The disease is always acute, and the formation of a fibrinous layer is the essential feature, which is cast off with a slight purulent discharge and the cure rapidly follows.

Treatment.—If only one eye is involved, seal up the good eye, though extension may take place through the general dyscrasia. *Cleanliness* is of the greatest importance, as in purulent conjunctivitis. Use no force in removing the false membrane, though all loose shreds should be carefully removed whenever the eyes are washed.

The application of caustic or strong astringents, especially in diphtheritic conjunctivitis, *is always injurious* except in the purulent stage, and then must be used very guardedly. Hot applications are better than cold except, perhaps, in the purulent stage. A solution of alcohol and water (℥j ad. ℥ij) has been employed locally with some benefit in diphtheritic inflammation; also, a one per cent. solution of Carbolic acid. Solutions of both Lactic and Acetic acid have been used locally with benefit. Lemon juice brushed over the surface of the conjunctiva every six hours is highly recommended by a number of physicians. In croupous inflammation Chlorate of Potassium, gr. xv-ʒi, has been useful as an external application.

The most serviceable remedies are *Acetic acid*, *Kali bich.*, *Apis*, *Argent. nit.*, *Lachesis*, *Phytolacca*, etc. See *Remedies in Conjunctivitis.*

FOLLICULAR CONJUNCTIVITIS is very frequently found and presents a very similar appearance to that met in trachoma, and is often mistaken for it. It consists of a simple hypertrophy of the lymph follicles.

Symptoms.—The conjunctiva appears filled with small, round, pinkish prominences, occupying the cul-de-sacs, especially of the lower lid, where they are first noticed and always more prominent. In advanced cases they are arranged in rows, running parallel with the margin of the lid, and later may involve the superior cul-de-sac and angles of the tarsus. Occasionally they may be found on the tarsus, where they appear as small, whitish, slightly raised patches. The condition comes on slowly and lasts for months or years.

Causes.—Usually results from bad hygienic surroundings and is often endemic in schools, asylums and prisons. This disease is often complicated by a catarrhal conjunctivitis when we have the symptoms of irritation, discharge etc.

Treatment.—Fresh air, change of climate and proper hygienic surroundings are a great aid to the cure of the trouble. Local applications have not proved of much benefit. Correct any error of refraction that may be present. Pressing out the contents of the follicles by Knapp's roller forceps will cure the disease in a much shorter time than under any other method of treatment.

The local use of corrosive sublimate as described under *Granular conjunctivitis* may be of service in this disease.

The internal administration of *Natrum mur.*, *Euphras.*, and *Sepia* has cured some of these cases. See *Remedies in Conjunctivitis.*

GRANULAR CONJUNCTIVITIS.—(*Trachoma, Egyptian Ophthalmia.*) Is an infectious inflammation and hypertrophy of the conjunctiva, that is characterized by its chronic course and a purulent infectious secretion. This disease has received numerous sub-divisions and classifications, we prefer that of *granular* and *papillary*. The great majority of cases, however, are of the mixed variety and so distributed that the most prominent feature over the lids is the papillary proliferation, while the trachoma granules are more characteristic toward the cul-de-sacs.

Pathology.—They consist of small rounded masses made up of lymphoid and connective tissue cells, surrounded by a fibrous capsule and traversed by blood-vessels and connective tissue fibres. Swanzy says: "The trachoma bodies have no capsule as have the follicles, but seem to grow from or in the stroma of the conjunctiva. They are to be regarded as new growths in the conjunctiva." De Wecker says: "A granulation lives and dies feeding on the parent that gave it life—it consumes the conjunctiva." Hence it is a malignant product, while follicles or purulent conjunctivitis are essentially benign.

Symptoms.—They appear as yellow or reddish-gray translucent, roundish elevations, looking like frog-spawn and are generally found in the retro-tarsal folds and at the angle of the lids in the earliest stages. When occurring in the conjunctiva over the tarsus they are smaller and less visible. They are oval in shape and broader and less prominent than the hypertrophied follicles. There is some drooping and swelling of the lids and a slight secretion of a purulent character, causing some agglutination of the lids in the morning. In the acute form there is considerable redness and hypertrophy of the conjunctiva sometimes hiding the granulations. The irritation of the eye and the quantity of the discharge is much increased in fresh cases or in acute aggravations of old cases. Pain, photophobia and lachrymation may be present and, during acute aggravations may become very severe.

Course.—The disease is usually very insidious in its onset and chronic in its course. In the majority of cases trachoma requires months or years to run its course. As it progresses the granulations increase in size, the conjunctiva becomes red and infiltrated, appearing as a fleshy mass, and secretes a muco-purulent discharge. Then a retrograde process sets in, and terminates in a cicatricial state with contraction of the conjunctiva. The formation of cicatrices is first shown by narrow whitish striæ in the red thickened conjunctiva.

Causes.—Trachoma is the result of infection from the secretions of an infected eye by some direct transfer, and is probably due to some *micrococcus.* It is usually met with in places where the population is overcrowded, ill-fed and amid unfavorable hygienic surroundings. True trachoma is very rarely seen among the better classes, but is often endemic in public institutions, asylums, etc.

Complications—The conjunctiva in long existing cases undergoes fibroid degeneration, atrophies and appears as grayish white cicatricial bands, usually running parallel with the border of the lid. The most frequent sequelæ are *trichiasis*, *entropium*, *ectropium* and *symblepharon.* The constant irritation of the cornea by granulations results in vascularity, infiltration and oftentimes ulceration of the cornea, a condition called pannus, and this may lead to softening and bulging, or staphyloma.

Prognosis.—In the early stages, when under careful treatment, resolution may occur in a short time. Later, however, the disease is more stubborn, its duration almost unlimited, and it leaves changes in the lid or cornea which may produce more or less serious disturbance of vision and even blindness.

DIFFERENTIAL DIAGNOSIS.

Granular Trachoma.	Papillary Trachoma.	Follicular Conjunctivitis.
Affects especially the upper lid—particularly the retro-tarsal fold. The granule is oval, reddish-gray and more or less opaque; it is imbedded in the membrane, and is less prominent than the follicles, usually takes on the mixed form, characterized by the presence of follicular and papillary hypertrophy in addition to the neoplasm. Frequently accompanied by pannus. Very seldom met with in children. Always leaves a cicatricial membrane.	Its location is predominantly over the surface of the tarsus instead of its borders. The enlarged papillæ are of a bright red or bluish-red color which gives the lid a velvety, injected appearance. Is more rapid in its onset.	Affects especially the lower lid, particularly the cul-de-sacs. The follicle is round or elongated, pael and semi-transparent; it is more prominent and sharply raised above the surface of the conjunctiva, and can be removed or separated from it. Its general arrangement is in rows parallel to the free margin of the lid. Never causes pannus. Found especially in children. Entirely recovers; leaves no cicatricial membrane.

PAPILLARY TRACHOMA.—Their elevations are mostly found on the surface of the conjunctiva over the tarsus, which gives to it a velvety appearance, and is always most pronounced upon the upper lid. There is also a proliferation of the epithelium. This gives the conjunctiva at first a red, roughened appearance, and later that of a swollen, bright red mass, studded with elevations.

Treatment.—Cleanliness and proper hygienic measures are very important aids in the treatment of this affection.

It should be remembered that the discharge from granular lids is contagious, and that whole families or a whole school may be inoculated from one member by an indiscriminate use of towels, etc.; therefore, strict attention should be paid to the prevention of its extension. All trachoma patients should have their own washing materials, linen, bed, etc., and in schools, institutions, etc., the cases should be isolated from the other inmates.

In acute trachoma or acute aggravations of chronic granular lids *ice compresses* will prove very agreeable to the patient and aid materially in controlling the intensity of the inflammatory process. In chronic granular inflammation of the conjunctiva, especially when complicated with pannus, which is usually present, local treatment will be found of the greatest service. The following topical applications have been followed by favorable results:

℞.	Acidi carbolici, ...	gtt. vj.
	Glycerini, ...	℥j.
	Misce.	
℞.	Acidi tannici, ...	gr. xxx.
	Glycerini, ...	℥j.
	Misce.	

They should be applied with a camel's hair brush to the everted lids once a day.

The local use of Corrosive sublimate in solutions of varying strength, from 1 to 1,000 to 1 to 200, gives extremely satisfactory results in many cases. It should be used by rubbing the lids energetically with a hard wad of absorbent cotton moistened in the solution. Under the use of Cocaine there is but little, if any, pain, and but slight inflammatory reaction occurs, except possibly from the stronger solutions. The scrubbing of the lids should be repeated two or three times a week, and if followed up yields the best results of any treatment we know of.

Operations of several kinds have been recommended in the past for excision of the trachoma bodies, but have been generally discarded. The most popular operation of today is that of expression with roller forceps, and in follicular conjunctivitis it is most thorough and satisfactory. Its results in trachoma, however, are not all that could be desired. As the operation is quite painful general anesthesia should be employed.

The lid is everted and one blade of the forceps is then pushed deeply into the fornix, and the other applied to the anterior portion of the everted lid; the forceps are then compressed and drawn forward, so that the tissue between the rollers is milked out. To reach the superior cul-de-sac, the tarsus may be drawn away from the eye with fixation forceps. Especial care should be taken to reach all parts of the conjunctiva at the fornix and commissures. The forceps should be frequently dipped into an antiseptic fluid in order to be kept clean and free from coagulated blood, which prevents the rollers from turning. Ice compresses will usually control the slight reaction that occurs.

At the same time local treatment is employed the carefully selected internal remedy should be administered. The selection will usually be from the following list: *Acon.*, *Aurum*, *Mercurius*, *Rhus tox.*, *Pulsat.*, *Sulph.*, *Nux vom.*, *Argent. nit.*, *Kali bich.*, *Alumen*, *Alumina*, *Arsen.*

PHLYCTENULAR CONJUNCTIVITIS. — (*Pustular, Scrofulous, Strumous and Herpetic Conjunctivitis.*)

Pathology.—Consists of a collection of lymphoid cells just beneath the epithelium raising it up. The apex breaks down, leaving a minute ulcer.

Symptoms and Course.—In the most simple form we find on the ocular conjunctiva a slight triangular-shaped injection, at the apex of which there is a small reddish eminence. There may be several of these, which may become absorbed, but usually the epithelial covering breaks down, forming an ulcer at the apex of the cone which then quickly heals. Again we may find a very pronounced redness with the formation of a very large phlyctenule at the border of the cornea itself, which will break down and form a large ulceration that may be some weeks in healing.

There are sometimes no subjective symptoms, but usually excessive lachrymation, violent pain, intense photophobia and blepharospasm. Frequently the child will lay with the eyes closed and the face buried in the pillow all day long.

The disease will usually run its course in from eight to fourteen days, but, as relapses or successive crops are particularly liable to occur, the eye may not be entirely free from the trouble for months or even years. The parents should always be warned that the child is liable to have recurrent attacks for years, often continuing until and ceasing with puberty. The *prognosis* is always favorable so far as the cure of individual attacks, the only danger being that subsequent attacks may involve the cornea and, leaving a macula over the pupil, affect in this way the vision.

Causes.—This is the most common eye disease of children and may be found in the perfectly healthy child though most frequently seen in those of a scrofulous diathesis. Errors of diet and bad hygiene are important factors. Often found with or after exanthematous diseases. Any irritating influence may cause it, such as errors in refraction, intra-nasal conditions, etc.

Differential Diagnosis.

Phlyctenular Conjunctivitis.	Catarrhal Conjunctivitis.	Episcleritis.
One or more small nodules usually at the corneal border. The phlyctenule forms the apex of a triangular-shaped congestion, the vessels running to the nodule. The vessels are more superficial and movable on pressure. Runs a rapid course.	Has no localized elevations. The inflammation is general and of the conjunctival vessels alone. Discharge is more or less profuse.	The elevation has a very much larger base, its color is dark. The congestion is much deeper, more of a bluish tint, and overlaying the scleral vessels are seen the conjunctival vessels, which by pressure are made to move over the swelling. Course very chronic.

Treatment.—The first points to be attended to are cleanliness and careful regulation of the diet. Prohibit all sweets and fats and confine the child mainly to milk, eggs, beef, mutton, etc. A compress bandage will relieve the photophobia and the irritation to the eyeball occasioned by their constant opening and closing. In some slow, indolent cases, the use of the following to stimulate into a more active condition is of value:

℞. Hydrarg. oxid. flav., ... gr. iv
Vaselin, ... ℥j
Misce.

Of this, a very small piece, not larger than the head of a pin, may be placed within the eye once or twice a day.

The most frequently indicated remedies are *Pulsat.*, *Sulphur*, *Hepar*, *Ipecac.*, *Graph.*, *Calc. carb.*, *Cham.*, *Conium*, *Mercurius*, *Rhus tox.*, *Euphras.*, *Antimon. crud.*, *Aurum*. See *Remedies in Conjunctivitis*.

REMEDIES IN CONJUNCTIVITIS.

Acetic acid.—A remedy of the first importance in croupous conjunctivitis in which the false membrane is dense, yellow-white, tough, and so closely adherent that removal is almost impossible.

Aconite.—In the first stage of any inflammation of the conjunctiva when the eyes are red, burning, very painful and with great dryness. The eyes are usually dry, but may be useful when there is a moderate lachrymation and a muco-purulent discharge. Especially useful in an inflammation from a foreign body, in acute catarrhal or an acute aggravation of granular lids and pannus. It is in the *Aconite* cases that ice is especially serviceable.

Allium cepa.—Of use in acute catarrhal conjunctivitis, the lachrymation is scalding, profuse and not excoriating.

Alumina.—In chronic granular lids where there is much marked dryness of the lids and eyes.

Antimonium crud.—In phlyctenular or pustular conjunctivitis, especially in cross children who are afflicted with pustules on the face and moist eruptions behind the ears.

Apis mel.—May be indicated in any form of conjunctivitis if there is great swelling (edematous) of the lids and adjacent cellular tissue. The discharge is moderate, pains stinging and shooting while the lachrymation is profuse, hot and burning, with photophobia.

Argentum nit.—Any form of purulent inflammation of the conjunctiva. The most intense chemosis with strangulated vessels, profuse purulent discharge and commencing haziness of the cornea, with a tendency to slough.

Arsenicum.—Acute catarrhal conjunctivitis with chemosis, much hot scalding lachrymation, burning pains, especially at night. In chronic forms if the lachrymation and discharges are thin and acrid, excoriating the lids and cheek.

Aurum mur.—Scrofulous ophthalmia, with ulceration and vascularity of the cornea. Useful in trachoma. Photophobia severe, lachrymation profuse and scalding; eyes very sensitive to touch.

Belladonna.—In the early stages of catarrhal conjunctivitis, if there is great dryness of the eyes. Photophobia is marked.

Calcarea carb.—Particularly indicated in phlyctenular keratitis and conjunctivitis and in some cases of trachoma, when due to exposure to wet. The eye symptoms are aggravated during damp weather. Catarrhal conjunctivitis in fat, unhealthy, strumous children.

Calcarea hypophos.—Purulent conjunctivitis, with ulceration of the cornea, occurring in patients who are very much debilitated, and who have little vitality.

Chamomilla.—Scrofulous ophthalmia in cross, peevish children during dentition.

Conium mac.—In phlyctenular inflammation with intense photophobia and profuse lachrymation. With all this intense photophobia there is very slight or no redness of the conjunctiva.

Euphrasia.—In catarrhal conjunctivitis, phlyctenular ophthalmia and trachoma. The lachrymation is excessive, acrid and burning. The discharge is profuse, thick, yellow, muco-purulent and acrid, making the lids sore and excoriated.

Graphites.—Phlyctenular conjunctivitis and keratitis, chronic catarrhal conjunctivitis. The photophobia is usually intense and the lachrymation profuse, the external canthi are cracked and bleed easily upon opening the eye. A thin, acrid discharge from the nose.

Hepar sulph.—In purulent ophthalmia if ulceration of the cornea is present. Intense photophobia, lachrymation and great redness of the eye, even chemosis. The lids may be swollen, spasmodically closed, bleeding easily upon any attempt to open them and very sensitive to touch. The discharge is considerable and of a yellowish-white color. When hypopyon is present *Hepar* is especially the remedy.

Ipecacuanha.—In phlyctenular ophthalmia, where there is much photophobia and redness of the eye.

Kali bichrom.—Both croupous and diphtheritic conjunctivitis, and trachoma with pannus especially indicated when the false membrane is present, if shreds or strings of it float loose in the eye. The discharge is of a stringy character and mixed with tears.

Mercurius.—Strumous ophthalmia, when the cornea is involved, ophthalmia neonatorum when the discharges are thin and excoriating and in gonorrheal or purulent conjunctivitis. The lachrymation is profuse, burning and excoriating, and the muco-purulent discharges are thin and acrid. The pains are generally severe, and are always aggravated at night.

Natrum mur.—This remedy has proven of value in follicular conjunctivitis.

Nitric acid.—Is especially advised for gonorrheal ophthalmia.

Nux vom.—In phlyctenular ophthalmia and trachoma, excessive photophobia and morning aggravation of all symptoms.

Pulsatilla.—Is one of our most valuable remedies in phlyctenular, catarrhal and purulent conjunctivitis. In phlyctenular particularly when the pustules are confined to the conjunctiva, in purulent when the discharge is bland and profuse. In trachoma when the granulations are very fine.

Discharges are generally profuse, thick, white or yellow and bland. The pains are relieved by the cool, open air.

Rhus tox.—Occasionally in catarrhal conjunctivitis and frequently in purulent ophthalmia. The lids are red, edematous and spasmodically closed so that we are compelled to use force to open them, when a profuse gush of tears takes place. The photophobia is intense.

Sepia.—Most valuable in those cases of recurrent conjunctivitis known as vernal catarrh, and in follicular or trachomatous conjunctivitis, which is only observed in or always made worse by hot weather. In pustular inflammation in women, either occurring with or dependent upon uterine troubles.

Sulphur.— In phlyctenular ophthalmia and in both acute and chronic catarrhal conjunctivitis, especially chronic, and occurring in scrofulous children covered with eruptions. The pains vary, though are usually of a sharp, lancinating character, as if a needle or splinter were piercing the eye; we may have a sharp, shooting pain going through the eye back into head from 1 to 3 A. M. All the symptoms are, as a rule, aggravated by bathing the eyes, so that the child cannot bear to have any water touch them.

VERNAL CONJUNCTIVITIS.—It is characterized by a phlyctenoid eruption on the conjunctival limbus, which becomes a swollen ring, more or less large, encircling the cornea; the growths are hard, uneven, and of a brownish, gelatinous appearance. It sometimes appears as a roughened granular condition of the palpebral conjunctiva, looking like a bluish-white film. Rarely it may affect both the ocular and palpebral conjunctiva at the same time. It affects children especially, and almost always attacks both eyes. The great characteristic is that it comes on every spring, lasting through the warm weather, and goes off with the cool days of autumn, and is entirely absent during the winter months.

Treatment.—*Sepia* and *Nux vom.* have proven of especial value in this disease.

AMYLOID DEGENERATION OF THE CONJUNCTIVA.—This is a very rare disease, which is occasionally confounded with granulations. It consists of an hypertrophy of the mucous membrane. The conjunctiva appears like a yellow gelatinous-looking mass, in the substance of which are semi-transparent granules, which are usually larger and more transparent than the granules of trachoma. On everting the lid the tarsus appears as though covered with wax. The tarsus is itself thickened and metamorphosed

Treatment.—Excision of the mass.

PEMPHIGUS.—This is an extremely rare disease, that is generally found with pemphigus of the skin. It is manifested by raw spots upon the conjunctiva, which become covered with a gray coating, and undergo cicatricial contraction. The cornea becomes cloudy and dry, and in the bad cases the lids become completely adherent to the eyeball (symblepharon) and the eye is incurably blind. Treatment of this disease has so far proved of little avail.

XEROSIS (*Atrophy of the Conjunctiva, Xerophthalmia*).—A dryness of the conjunctiva from atrophy. Where the whole stroma of the conjunctiva is affected it is called *parenchymatous*, and where the atrophy is superficial it may be called *partial* or *epithelial*. When confined to only a part of the mucous membrane it is called *xerosis glabra*, and when it occupies the entire surface *xerosis squamosa*, and in the latter the cornea is usually affected, when it is termed *xerophthalmia*. This condition is usually caused by inflammations that leave cicatrices, as in diphtheritic and granular conjunctivitis and burns of the conjunctiva.

Epithelial xerosis is more common, and is usually a sequela of conjunctivitis vernalis, although it may be idiopathic. In this form we may find grayish-white patches of a satin-like lustre on the conjunctiva and most often on that part of the ocular conjunctiva left uncovered when the lids are opened.

In complete xerosis the conjunctiva is pale and dry, with small scales; the cul-de-sac and semilunar folds are obliterated. The cornea is opaque, atrophied and diminished in all of its diameters. The Meibomian glands are atrophied, the ducts of the lachrymal gland and the puncta lachrymalis are obliterated. The absence of secretion causes dryness of the eye and the movements are limited by the retraction of the mucous membrane and the adhesions.

Treatment.—Can only be palliative, that is, ameliorate the excessive dryness which gives rise to so much heat and pain. Milk answers the purpose very well, or a weak solution of glycerine and water, to which one per cent. of salt should be added.

PTERYGIUM.—Is a vascular, triangular thickening of a portion of the conjunctiva, with its apex resting on the edge of the cornea. The most frequent location of a pterygium is over the internal rectus muscle, less frequently over the external rectus. Pterygium grows very slowly and has a tendency to spread over the cornea, though rarely seen to grow beyond the centre of the pupil.

It is claimed by some to be due to a preceding pinguecula and occurs mostly in individuals who are exposed to constant irritation of the conjunctiva, from dust, etc., and is only found in adults. The cornea remains opaque after its removal, and the growth may recur.

Treatment.—Numerous operative methods have been advocated, chief among which are excision, ligation and transplantation.

Excision is perhaps the best and most frequently performed. The pterygium is raised with the forceps, a narrow knife is passed under the growth and a cut made to the corneal border; then, with a strabismus hook, pull it off from the cornea and with the scissors cut off at the base with converging incisions and unite the edges of the membrane with sutures—usually three.

Ligation is performed with a thread having a needle at each end. Raise the growth with the forceps and pass one needle from above downward under the growth near the cornea and the other at the base of the pterygium; now cut off your needles and tie the sutures; one takes in the base, the second the apex, and the third detaches it from its posterior surface.

Transplantation is by detaching from the cornea and sclera so that it adheres only by the base; then make an incision in the conjunctiva below and parallel to the cornea and fasten the apex of the growth in this incision with sutures. When large it may be divided and inserted half above and half below the cornea.

SUBCONJUNCTIVAL HEMORRHAGE, or an effusion of blood beneath the conjunctiva, may come from a blow, operations, or anything causing cranial congestions—the lifting of weights, coughing, vomiting, etc. It is quite common in old people with atheromata, and occurs in children with whooping-cough, from vomiting, etc. Appears as a patch or deep red ring around the cornea. Looks alarming, but is generally of no importance, gradually disappearing of its own accord and presenting various shades during the process of absorption.

Treatment.—Ice compresses in the early stage to check the bleeding, and later hot applications may be used to promote absorption. *Arnica*, *Ledum*, *Hamamelis* or *Calendula* will be of service.

TUBERCULOSIS OF THE CONJUNCTIVA is a very rare disease that usually commences in the conjunctiva of the upper lid, occurs in young subjects and is apt to affect but one eye. On everting the lid we see isolated nodules resembling trachoma granules, which later break down into ulcerations.

Treatment.—The use of the galvano-cautery, as well as the knife to destroy the local products is recommended.

LESIONS OF THE CONJUNCTIVA.—*Foreign bodies* penetrate the conjunctiva and may cause irritation, if not removed early. They are frequently found on the inner surface of the upper lid.

Wounds from sharp instruments, so long as they do not involve other structures, are not important and readily heal. When extensive clean the wound carefully, unite the edges with sutures and apply cold compresses.

From burns and cauterisms by chemical reagents there are caused thick, whitish patches that project above the mucous surface and may result in severe pain and inflammation. Danger depends on the size, their influence on the cornea and the amount of cicatrization causing symblepharon. Oil should be used in all burns.

Injuries from lime are, unfortunately, of frequent occurrence and very dangerous on account of the formation of deep sloughs, which have a great tendency to result in symblepharon. If seen early, we should endeavor to remove as much as possible of the lime and then drop into the eye either a little olive oil, oil of sweet almonds, milk, weak solution of vinegar, or some substance which will unite with the lime and form an innocuous compound. Water should never be employed. Great care should be taken while the wound is healing that no adhesions between the lids and ball occur. If there is a tendency in this direction, the adhesions should be broken up once or twice a day by means of a probe.

Injury from strong acids, as sulphuric or nitric, require the use locally of a weak solution of carbonate of soda or potassa (grs. x to ℥iii) in order to neutralize the acid; afterwards olive oil should be dropped in. To relieve the severe pain a few drops of a 4% solution of cocaine may be instilled.

TUMORS OF THE CONJUNCTIVA.—Nearly all varieties of tumors, either benign or malignant, may occur in the conjunctiva, and will be but briefly referred to.

The congenital growths are *dermoid*, *angioma*, *lipoma*, *cysts* and *pigment spots*. Among the benign tumors found having their origin in the conjunctiva are *fibroma*, *papilloma*, and *osteoma*.

Among the malignant growths are *lupus*, *epithelioma* and *sarcoma*.

Treatment.—Simple excision of the benign growths is all that is required, but in the malignant growths it is often necessary not only to enucleate the eyeball, but sometimes exenteration of the orbit.

CHAPTER X.

DISEASES OF THE CORNEA.

Anatomy.—The cornea is nearly circular in shape, though slightly more prominent in youth than in old age. It is perfectly transparent and this transparency is due to the arrangement as well as the individual transparency of each of its constituent elements. The cornea is composed of five layers which, taken from without inward, are the anterior epithelial layer, Bowman's membrane, the substantia propria, Descemet's membrane and the posterior endothelial layer.

The *anterior epithelial layer* is like the epithelium in other parts of the body, though in this location it is continuous with that of the conjunctiva and is composed of from six to eight layers of cells, varying in size and shape.

Bowman's membrane is simply a layer of corneal cement. It is closely adherent to the cornea proper and cannot be separated from it as a distinct layer.

The *substantia propria* is made up of extremely fine connective tissue fibrillæ united into the fasciculi. A cement substance binds the fibres and fasciculi together. There is a system of spaces, lacunæ, and lymphatic canals, canaliculi which are a continuation of the lymphatic vessels and spaces. The corneal cells fill these lacunæ and their branching arms the canaliculi.

The *fibrillæ* and *fasciculi of fibres* are disposed in layers one above the other, forming in this way a structure made up of the lamellæ, about sixty in number.

The *cement* is a homogeneous substance binding the fibres and fibrillæ together.

The *corneal spaces* are hollowed out of the compact tissue formed by the cement and the fasciculi arranged in lamellæ and are composed of numerous lenticular-shaped shallow spaces communicating together by off-shoots or canaliculi. These spaces have no proper lining and vary in size. They run from one layer to another and even penetrate between the fibres, thus forming a network throughout the corneal tissue. The canals convey the lymph for the nourishment of the cornea and the spaces contain the cells of the cornea, which are of three varieties—the fixed cells or corneal corpuscles, the migratory and the pigment cells.

The *fixed cells* lie in the lacunæ, are flattened, have both nuclei and nucleoli and send prolongations into the canals.

The *migratory cells* are distinguished from the fixed by their large and variable size, their brilliancy and the power of motion. They correspond to leucocytes and increase in number during inflammation.

The *pigment cells* are similar to the fixed cells, found only at the periphery of the cornea and especially present in negroes.

Descœmet's membrane is the inner lining of the parenchyma. It is a structureless, homogeneous membrane, of a glassy appearance and highly refractive. It is firm and elastic, and is supposed to be a condensation of the cement substance of the cornea proper.

The *endothelial layer* consists of a single layer of endothelial cells lining the posterior surface of the membrane of Descemet. The cells are flat and of varying shape and distinctly nucleated.

Blood-vessels are only found on the outskirts of the cornea and are derived from the anterior ciliary arteries.

The nerves of the cornea, about forty in number, penetrate its tissue, lose their medullary sheath, become transparent and divide dichotomously to form large plexuses, which ultimately end in a fine plexus beneath the anterior epithelium. From this subepithelial plexus fibrils are given off which pass among the epithelial cells.

PHLYCTENULAR KERATITIS—(*Eczematous*, *Scrofulous*, *Strumous*, or *Pustular Keratitis*).

Pathology.—Consists of a circumscribed infiltration of leucocytes into Bowman's layer.

Symptoms.—We will first notice small, grayish elevations varying in size upon some part of the cornea, usually the periphery. There will be a redness which may encircle the entire cornea, or more often, where there is but one phlyctenule, triangular-shaped injection, the apex of which will be at the point of infiltration. The photophobia is often so intense that it will be found difficult to open the eye for examination. Again, other cases will be met with in which there is not the slightest photophobia. Generally, the infiltration is surrounded by a zone of opaque and swollen cornea; the apex breaking down, it extends in circumference and depth and forms an ulcer which becomes covered with a layer of epithelium and fills up, the cornea regaining more or less of its transparency.

Course.—It is usually acute, though it may be very chronic, as there is a great tendency to relapses.

Causes.—It is most frequently found in children and young persons of a weakly, scrofulous constitution and those of a nervous, excitable temperament. It is often found after the exanthematous diseases or in eczema of the face, from confinement in close, dusty rooms, after exposure to cold or moisture.

Prognosis.—Each attack in itself should be promptly treated, when it will usually heal in a short time, as it yields readily to treatment. When due to scrofula there will probably be relapses and more or less loss of sight will occur from macula, if the location be central.

Treatment.—As the treatment of this disease is precisely the same as that for phlyctenular conjunctivitis, what is there said applies as well to phlyctenular keratitis and avoids unnecessary repetition. (See *Phlyctenular Conjunctivitis.*)

FASCICULAR KERATITIS.—Consists of a vascularized infiltration in which there is a narrow band of vessels running parallel to each other and extending into the cornea. At the end of this fasciculus of vessels there is a crescentic-shaped infiltration, which is often ulcerated. There are the usual symptoms of pericorneal injection, photophobia and lachrymation. The affection is mostly found in scrofulous children and its treatment is the same as that for phlyctenular keratitis.

VASCULAR KERATITIS (*Pannus*) is a condition usually accompanying trachoma, and is the result of friction on the cornea by the roughened lids.

Pathology.—There is a formation of a neoplastic layer of cells beneath the epithelium and also in the corneal layers just beneath Bowman's membrane. These cells develop into connective tissue, and blood-vessels, and capillaries form in them.

Symptoms and Course.—In the acute form of the disease we may find photophobia, lachrymation, ciliary neuralgia and redness. When it becomes chronic, the irritability is but slight. The cornea becomes opaque, rough, uneven and filled with ridges. The disease usually extends from the periphery, where it is the thickest, to the centre, but it may be the reverse. Superficial and even deep ulcers may form in the pannus.

Causes.—In a large majority of cases it is due to trachoma, or from the friction and irritation due to inverted eyelashes, entropium or chalazion.

In chronic cases the normal transparency of the cornea can never be restored and the ultimate effect upon the vision will depend upon the extent of the corneal invasion.

Treatment.—This should, of course, be mainly directed to the cause of the pannus, as elsewhere described. The general health should be promoted and the eyes may be protected from all intense light. In some of the indolent cases, where the pannus is dense and does not clear up after the relief of the cause, the use of warm fomentations applied for about one-half hour at a time, two or three times a day, together with massage with the yellow oxide ointment, may be of service. *Atropin* may be of service where the vascularity is excessive and should be used when there is a tendency to iritic complications. The operation of *peritomy*, in all cases due to trachoma where the cornea remains opaque and vascular after the granular lids have passed over into the cicatricial stage, may sometimes be very serviceable. The operation consists in dissecting away a narrow strip of the conjunctiva close to the corneal border for either a portion or the entire circumference of the cornea. The galvano-cautery can be used for the same purpose to burn a narrow strip around the cornea.

The administration of the homeopathic remedy is often the most essential part of the treatment. *Acon.*, *Aurum*, *Hepar*, *Merc. sol.*, *Rhus tox.* and *Sulphur* are perhaps the ones most often of value. For special indications see remedies for ulcer of the cornea.

HERPES OF THE CORNEA (*Vesicular Keratitis*).

Small roundish vesicles filled with serum appear upon the surface of the cornea. They are due to a circumscribed upraising of the epithelium, in which a thin layer of the cement substance takes part. The disease appears in paroxysms, with very severe pain, which is only relieved upon the shedding of the vesicular envelope and the formation of a slight excoriation.

Cause.—The cause of this affection is probably some inflammatory change in the fifth nerve, as evidenced by its frequent association with ophthalmic herpes zoster.

Diagnosis. — This disease may be mistaken for phlyctenular keratitis, but in this the elevations are clear, while in phlyctenules they are flatter and more greyish in color. In herpes there is no vascularization and the disease is rarely found under puberty. Phlyctenular keratitis is usually associated with more or less vascularity and is a disease of childhood.

The *treatment* should be by the application of warm fomentations, instillations of Cocaine, electricity and the removal of the epithelial covering of the vesicle with forceps.

ULCER OF THE CORNEA.—The clinical sub-divisions of the corneal ulcers are almost innumerable; we shall, however, study all ulcers under one general heading, with brief mention of one or two of the more distinctive varieties to follow.

Pathology.—There is at first an infiltration of leucocytes into the cornea lamellæ lying next to Bowman's membrane. The number of these cells increases and Bowman's layer, together with the epithelium, becomes raised, necrosis then sets in. The ulceration heals by a rapid proliferation of the epithelium and a new formation of connective tissue. This new tissue is translucent and never becomes transparent. The ulcer may, however, extend either in breadth or depth, involving the whole cornea or penetrating into the anterior chamber.

Symptoms.—The eye is usually closed from excessive photophobia and on attempting to examine the eye it rolls upward under the lid and a flow of tears will result. Very rarely there will be no photophobia or lachrymation. Some redness is generally present and upon examination of the cornea we find an irregular, opaque depression with occasionally blood-vessels running to the ulcer from the corneal margin. Hypopyon, or pus in the anterior chamber, is quite frequently found and more rarely a bulging of Descemet's membrane in the base of the ulcer (*keratocele*).

Subjectively the patient will usually complain of more or less intense photophobia, lachrymation and ciliary neuralgia, all due to an exposure of the terminal filaments of the corneal nerves, and from this we will sometimes find a slight superficial ulceration, creating more disturbance than may be present in a deeper and far more serious ulcer.

Course.—In a majority of cases the course of an ulcer is acute and rapid, but in others it may be chronic and protracted, obstinately defying all treatment until perhaps perforation has taken place, when it will at once begin to heal. The extension of the ulcer may take place in one direction while repair is going on at the other end (*serpiginous*).

Causes.—Corneal ulcers frequently occur from some form of conjunctivitis, and are apt to vary in degree, according to the severity of the conjunctival disease, from a superficial abrasion to a slough of the entire cornea. Injuries, foreign bodies, wounds or operations, friction from inverted eyelashes, from calcareous concretions or foreign bodies in the tarsal conjunctiva or colds, may cause either an ulcer or an abscess. Paralysis of the orbicularis palpebrarum, ectropium, exophthalmic goitre, etc., cause ulcerations from exposure of the cornea to external irritants. Deficient nutrition in children, and the exanthematous diseases are very common causes.

Prognosis.—Favorable as a rule, but depends upon the condition of the ulcer, and upon the age and general condition of the patient. When situated near the centre of the cornea the vision is much interfered with, and when more peripheral the vision is but slightly, if at all, affected. All ulcers except the most superficial leave scars. Ulcers that heal with vascularization of the cornea leave opacities. In children there is always a more complete regeneration than in advanced age. Very deep ulcerations from ophthalmia neonatorum may heal with only a slight opacity. In cases of *central* ulceration always advise the patient at the first examination that there will be more or less loss of vision. Opacities are called nebula, macula or leucoma, according to their density. A *nebula* is a slight, thin opacity; a *macula* is larger and more opaque, and a *leucoma* is denser and still more opaque.

Results.—If an ulceration extends and causes a perforation of the cornea, a long train of results may follow. When the perforation occurs, the aqueous flows off and the iris and lens come forward into apposition with the cornea. In large perforations the iris falls into its margins, or bulges through, and, the cornea healing, it is held there as an anterior synechia, or prolapsed iris; the latter, exposed to external irritants, may become the starting-point of a purulent irido-choroiditis. If the entire cornea is destroyed there is a total adhesion of the iris to the cornea (leucoma adherens) and the new cicatricial tissue may not withstand the intra-ocular pressure, and staphyloma results, or it may flatten and atrophy of the globe follow. If the rupture of the cornea is extensive and sudden, there may occur a dislocation of the lens or even its escape from the eye, a prolapse of the vitreous, or an intra-ocular hemorrhage. Occasionally a perforation will not heal, leaving a fistula of the cornea.

Treatment.—Our chief reliance must be placed upon the carefully selected homeopathic remedy. If the ulceration should be due to granular lids, inverted eyelashes, etc., the cause should, of course, be removed if possible.

In the treatment of ulcers and abscesses of the cornea, local and dietetic measures are of great importance. If the ulcer is extensive, the patient should be directed to remain quiet in the house (in bed, if possible), that absolute rest may be obtained. As this disease is more often found in weak, debilitated subjects, a very nutritious diet should be prescribed, and it may even be necessary to use stimulants.

As a rule, *cold applications* are injurious, except occasionally in the first or inflammatory stage of superficial keratitis, or in ulceration of the cornea occurring during the course of pannus. *Poultices* also are not advised, except in indolent ulcers which are deep, nonvascular and have no tendency to heal, in which they may often be employed with advantage.

Moist heat applied from ten to thirty minutes and used from three to eight times a day has been highly recommended by Veasey. He uses three or four pieces of lint or flannel about three inches in diameter, dipped in hot water and laid over the closed eye and changed about every one to one-half minute.

Bandaging, is often of great importance, even in some cases producing a cure alone. In all cases of deep and obstinate ulcer a protective bandage should be immediately applied. The objects of the bandage are, to keep the eye quiet and protected from all irritating causes, such as wind, dust, etc., and to keep the eye warm, in order to promote local nutrition.

Atropin is usually required in ulcers or abscesses of the cornea, only when the ulcer is central and has a tendency to perforate, or if iritis complicates the corneal trouble. It may also be of service in relieving the great irritability and intense photophobia observed in some obstinate forms of corneal inflammation.

Eserin should be instilled if the ulcer tends towards perforation at the periphery, or if the intra-ocular tension becomes increased. It is also claimed to have a curative effect on the ulceration itself.

Warm solutions of chlorine water, bichloride of mercury (1:5000), formaldehyde (1:3000), etc., may be used to cleanse the ulceration of pus and place it in the best condition for healing.

The use of the *galvano*, or *actual cautery*, to lightly touch the ulcerated surface, under cocaine, has proven most valuable in many severe cases.

Curettement has often resulted in the quick healing of an ulcer. This is made by gently removing the slough from the sides and base of the ulcer and under cocaine is quite painless.

In those cases in which the ulcer is deep, with a great tendency to perforate, *Sæmisch's incision* is recommended. It consists in cutting through the base of the ulcer with a Graefe cataract knife, from the healthy tissue on one side to the healthy tissue on the other, after which Atropin is instilled and a compress bandage applied.

Paracentesis may also be resorted to. The puncture should be made with a fine needle, through the deepest portion of the ulcer, the aqueous allowed to flow off as gently as possible and a compress bandage applied.

All ulcers should be closely watched, that we may detect any hernia of the cornea or prolapse of the iris as soon as they occur. If a prolapse has taken place and is of recent origin, we should endeavor to replace it with a probe or by dilating or contracting the pupil according to its situation; if this proves inadequate, the protruding iris should be snipped off with a pair of scissors, Atropin instilled and a pressure bandage applied.

In some very indolent ulcers the application of a mild irritant, such as the powdered calomel, or the yellow oxide of mercury ointment, will materially aid the process of repair.

Hepar.—Especially for the deep, sloughing ulcer and when hypopyon is present.

There is intense photophobia, profuse lachrymation and great redness of the cornea and conjunctiva, even chemosis. The pains are severe and of a throbbing, aching, stinging character, ameliorated by warmth and aggravated by cold or uncovering the eye in the evening. There is marked sensitiveness of the eye to touch.

Mercurius sol.—Is adapted to both superficial and deep ulceration, especially in syphilitic or strumous subjects. The lachrymation is profuse, burning and excoriating, while the discharges are thin and acrid in character. The pains are always aggravated at night. The lids are thick, red, swollen and excoriated by the acrid discharges.

Calcarea carb.—Corneal ulcerations found in fat, unhealthy children with large abdomens, who sweat much, especially about the head, and are very susceptible to cold air.

Calc. iod.—Ulcerations in strumous subjects, with enlargement of the tonsils and cervical glands.

Calc. hypophos.—In deep sloughing ulcers or abscesses found in weak, debilitated individuals.

Arsenicum.—The photophobia is usually excessive and the lachrymation hot, burning, acrid and profuse. The burning pains predominate and are worse at night, especially after midnight.

Rhus tox.—Superficial keratitis, with excessive photophobia and lachrymation, so that the tears gush out upon opening the spasmodically closed lids. Keratitis caused from exposure in the water.

The lids are edematously swollen, especially the upper. The symptoms are generally worse in damp weather and at night after midnight.

Conium.—In superficial ulceration in which the surface of the cornea only is abraded. There is intense photophobia and much lachrymation, but very little or no redness of the conjunctiva.

Sulphur.—Both acute and chronic cases. Pus may be present in the anterior chamber. Ulcerations occurring in or dependent upon a scrofulous diathesis. The pains are sharp and sticking as if a needle or splinter were sticking in the eye, or there may be sharp, shooting pains through the eye into the head from one to three A. M. The intolerance of light is generally great and the lachrymation profuse.

Mercurius prot.—Serpiginous ulceration of the cornea that commences at the margin and extends over the whole cornea, or a portion of it, especially in the upper part, involving only the superficial layers. The vascularity of the cornea and conjunctiva is usually great, while the photophobia is excessive.

Kali bichrom.—Indolent ulceration, in which there is no active inflammatory process, therefore marked by no photophobia and no redness.

Graphites.—Scrofulous children who are covered with eczematous eruptions, particularly on the head and behind the ears; eruptions are moist, fissured and glutinous. Is especially adapted to superficial ulcerations resulting from pustules. The photophobia is usually intense. The lids are covered with dry scales, with cracking and bleeding of the external canthi.

Profuse, acrid, burning lachrymation, together with profuse, acrid, yellowish-white, muco-purulent discharge from the eyes.

Ipecacuanha.—Vascular ulceration of the cornea, with much photophobia.

Pulsatilla.—Thick, bland, white or yellow discharge from the eyes and general amelioration of the symptoms in open air.

Silicea.—Sloughing ulcers; also small, round ulcers which have a tendency to perforate.

Cinnabaris.—Pain above the eye, extending from the internal to the external canthus or running around the eye.

Argentum nit.—Ulcerations of the cornea in new-born infants, or from any form of purulent ophthalmia, with profuse discharge from the eyes.

Aconite.—Superficial ulceration of the cornea of traumatic origin.

Aurum.—The photophobia is marked, lachrymation profuse and scalding and the eyes very sensitive to touch.

Chamomilla.—Ulceration occurring in cross, peevish children during dentition.

Apis, *Chininum mur.*, *Nux vom.*, *Euphras.*

HYPOPYON ULCER (*Serpiginous*, *Infectious*).—The progressive course of this ulcer, from which it derives the name of serpiginous, is by infection.

Symptoms and Course.—In the inflammatory or active cases there is very severe pain and photophobia, with redness of the conjunctiva and some muco-purulent discharge. The ulcer may develop at either the margin or the centre of the cornea as a slight loss of substance, usually oblong in shape, its base appears grayish, its edges raised and mottled or streaked with white. The hypopyon increases as the ulcer spreads and gives the base of the ulcer a yellow color. The rapidity of the ulceration is such that the entire cornea may be eaten away in two or three days. The ulcer always extends from its border, steadily and rapidly, either directly across, or around the entire cornea. In this way the nourishment of the cornea is cut off and slough of the entire cornea may ensue. It has a great tendency to extend in depth as well as laterally. When a large perforation takes place, allowing of the escape of the hypopyon, repair may then set in. In the early stages of this disease there is usually excessive pain, but later on, owing to the cutting off of the corneal nerves by the ulceration, pain may be wholly absent. The disease may occasionally make its appearance in a far less acute attack, in which the inflammatory symptoms and pain may be so moderate that the subject will allow the condition to go on for several days before seeking advice, when we may find a considerable portion of the cornea affected, and the anterior chamber may be half full of pus. An extension of the ulceration may be going on at one extremity and repair at the other.

Causes.—It is most generally found in the poorer classes, where, from want of care, decomposed matter is allowed to sojourn in the conjunctival sac. In the better classes the septic material is usually the outcome of an inflamed lachrymal sac, the secretion being retained and decomposed. Any abrasion from chips of stone or metal, or simple epiphora, by maceration of the epithelium, gives an opportunity for the infection. The disease nearly always occurs in adults over forty years of age.

Treatment.—In this form of ulcer we frequently have to resort to the Sæmisch incision described under the treatment of ulcers, or to the galvano-cautery loop, or as Gruening advises the point of a delicate platinum probe, brought to a red heat in a spirit lamp, held behind the patient. The lids are separated and the eye steadied by the fingers of the left hand of the operator, while with the right hand the red hot point is applied to the arc or zone of propagation. The eye having been previously cocainized, the patient suffers no pain. Under the compress bandage the eschar is thrown off in twenty-four hours, leaving a clean ulcer which heals rapidly. The cautery destroys the septic matter covering the walls and base of the ulcer, and by penetrating the cornea either with the cautery or the knife we remove, by the escape of the hypopyon, the septic material from the anterior chamber. Other treatment, both local and medical, will be found under treatment of ulcer of the cornea.

RODENT ULCER.—Unlike the hypopyon ulcer runs a very slow chronic course, often lasting for months, and affects only the superficial layers of the cornea. It appears as a small gray infiltration near the corneal margin which ulcerates, and when appearing to heal, relapses set in and more tissue is involved until it has extended over the entire cornea. It is accompanied by decided irritation, pain, photophobia, lachrymation and ciliary injection. The disease usually involves both eyes, occurs in debilitated people past middle life, and as it eats away the whole surface of the cornea results in complete loss of sight.

Treatment.—The cautery should be used to arrest the disease. Atropin and the bandage are of service to relieve the pain. For remedies, see *Ulcer of the Cornea.*

INDOLENT ULCER.—(*Absorption Ulcer, Clear Ulcer.*)—It is but rarely seen, and most often in the central part of the cornea. The edges are jagged and outlines irregular, though more or less circular. This ulcer may remain stationary for weeks or months, then the edges may become vascular, the margins rounded off and the loss of substance be restored. Repair is often more or less incomplete and a slight facet may remain.

Treatment. — Warm applications and a compress bandage may be applied and local irritants may be used to stimulate the ulcer. For remedies, see indications under *Ulcer of the Cornea*, especially *Con.*, *Kali bich.*, and *Nux vom.*

MARGINAL RING ULCER.—(*Circular Ulcer.*)—Is a deep, clear cut ulcer occurring at the corneal margin. There is but very slight infiltration and it may extend all around the cornea, causing a slough by cutting off the nutrition of the cornea. It is a very rare form of ulcer, occurring usually in adults or old people whose nutrition has fallen very low, but may occur in children from a marginal phlyctenular infiltration.

DENDRIFORM ULCER.—(*Malarial, Mycotic and Furrow Ulcer.*)—Under these various headings have been described a superficial ulceration of the cornea, all of which have the one general appearance of narrow furrows with offshoots or ramifications which follow a crooked or zigzag course over the cornea. In these cases there may be very intense photophobia, lachrymation and neuralgic pains in the eyes, with but little inflammation or infiltration. It is generally considered to be due to some particular microbe and is apt to be rather chronic in its course.

Treatment.—Scraping the bottom of the ulcer with a sharp spoon and the local use of a $\frac{1}{1000}$ solution of corrosive sublimate has proven of decided value in this form of ulceration. *Ipecac.*, *Conium* and *Hepar* have been the most serviceable remedies in my hands.

NEUROPARALYTIC KERATITIS.—The cause of this fortunately rare disease is a paralysis or injury of the ophthalmic division of the fifth nerve; which results in a loss of sensibility of both the cornea and conjunctiva, thus allowing external irritants to remain in contact with the cornea and create a traumatic inflammation. The cornea becomes dull and cloudy; the epithelium of nearly the entire cornea is thrown off. The cloudiness of the cornea at its centre increases, breaks down into pus and a large ulcer with hypopyon is formed. The course of the disease is slow and characterized by absence of pain and slight symptoms of irritation.

The *prognosis* is bad, as dense opacities form over the entire cornea.

Treatment should be to protect the eye from external irritants with a compress bandage. The use of electricity to stimulate the nutrition of the nerve is of great value. Otherwise, the treatment should be that of ulcers in general. *Sepia* has given very excellent results in this disease.

BULLOUS KERATITIS.—This is characterized by an elevation of the epithelium of considerable size and of a sacciform appearance. Its approach is accompanied by a severe attack of peri-orbital neuralgia, photophobia and acute congestion of the eye. After a few days rupture of the bullæ takes place and a more or less deep ulceration remains, which finally heals as described under ulcers. The pain in this affection is usually very severe, paroxysmal in character and ceases after the breaking of the covering. The disease usually follows upon other diseases of the eye, such as glaucoma and irido-cyclitis. There seems to be a great tendency to recurrence.

Treatment.—To relieve the pain, remove the envelope of the bullæ and then treat as an ordinary ulcer.

ABSCESS OF THE CORNEA.—By corneal abscess we mean a circumscribed collection of pus within the layers of the cornea.

Pathology and Course.—There is at first an infiltration of round cells into the corneal tissue. The pressure from these cells causes a mortification and fatty degeneration of the parts involved, and thus a pus cavity, filled with round cells and a fatty, cheesy detritus is formed. The surrounding corneal tissue is also infiltrated. The abscess *may* heal at this stage without further destruction. As a rule, however, more cells immigrate and are formed within the cavity and this process usually extends until the outer surface is reached and an ulcer is formed. Lastly, the abscess may extend in both directions at the same time and result in a perforation of the cornea.

Symptoms.—There appears a round, circumscribed, gray opacity in the deeper layers and usually at about the centre of the cornea in which may be seen short, gray striæ. Photophobia, lachrymation and ciliary neuralgia are, as a rule, very severe. There are usually violent symptoms of irritation, such as intense injection of the conjunctival and ciliary vessels; chemosis even is very apt to be present. The pupils are contracted, iritis is apt to be present, and hypopyon is usually found. The disease, as a rule, is a most painful one; the terrible pains causing sleepless nights, etc., often radiate to the occiput and teeth. Very rarely we will meet cases of torpid abscess with but slight symptoms of irritation. Sometimes there are several superficial infiltrations close to each other, which may extend in circumference and depth, coalesce and give rise to a large abscess which may leave a dense opacity or lead to an extensive slough of the cornea. The disease usually shows a tendency to extend in depth rather than breadth. Relapses may occur and the affection thus becomes chronic in character.

Causes.—The infection may arise from the substance that causes the abrasion, or may be present in the conjunctival sac, due to catarrh, trachoma or blennorrhea of the lachrymal sac. This form occurs almost exclusively in adults of the laboring class. The infection may also occur through metastasis, as in smallpox, typhus, scarlet fever, etc.

Prognosis is, as a rule, unfavorable, as a permanent opacity, more or less extensive, always remains.

Treatment.—(See *Ulcer of the Cornea.*)

DESCEMETITIS (*Punctate Keratitis*).—This disease is most frequently described as a *punctate keratitis.*

Symptoms. — Pain, photophobia, lachrymation, ciliary injection, dilatation of pupil and hypersecretion of aqueous humor are all of a low degree, and may or may not be present. There are, however, on *the posterior* *surface of the cornea more or less numerous small, grayish or dirty-white points*, especially found over the pupil. These deposits are usually absorbed.

The condition described is very frequently associated with a serous inflammation of the iris or uveal tract, still I am convinced that it can occur primarily.

Treatment.—The chief dependence is upon the use of the homeopathic remedy. *Kali bich.* has proven in our hands to be the remedy in this disease. Others, such as *Gels.*, *Aurum*, *Calc.*, may be of service.

INTERSTITIAL KERATITIS (*Parenchymatous, Diffuse, Syphilitic Keratitis*).

Pathology.—An infiltration of round cells with, a little later, proliferation of the corneal fixed cells. This infiltration usually heals by absorption. When absorption does not take place, the infiltration produces sclerosis of the involved part.

Symptoms.—The characteristic appearance of the cornea is that of a deep-seated grayish opacity, accompanied by slight injection of the ciliary vessels. The opacity usually commences at the periphery of the cornea, and gradually extends concentrically from all sides toward the centre, but in some cases the centre is first affected. The density of the infiltration is always thickest at the centre over the pupil. The cornea is frequently so opaque that the iris is quite invisible. The color of the opacity also depends upon its density, assuming a decidedly yellow hue at the thickest part and from that shading to white at the inner spots. The extent of the irritation and inflammation varies so much that some authors speak of it as of two forms—the vascular and non-vascular.

We find the majority of the cases of the disease without any vascularity of the cornea and occasionally without any congestion of the conjunctiva; but, as a rule, there is more or less pericorneal injection together with photophobia, lachrymation and pain, which are usually more pronounced the greater the amount of vascularization.

Occasionally the vascularity of the cornea will be so great that the appearance will be that of an extravasation of blood into the corneal layers. The vision is always impaired if the centre of the cornea is involved and often to such an extent that only shadows are discernible. Interstitial keratitis is frequently complicated with inflammation of the uveal tract.

Course.—Both eyes are usually affected in this disease, commencing generally in one eye, and when this is well advanced the second will become inflamed, or sometimes the second eye will not be involved until long after the first has recovered.

The course of the disease is very slow and protracted; in fact, it may last from three months to as many years, although as a rule the majority of cases will recover in from two to ten months. In most cases the infiltration will seem to steadily increase, regardless of all treatment, for one to three months before it reaches its height, where it will seem to remain nearly stationary for a short period and then begin gradually to clear up from the margin, the central portion over the pupil being the last to clear.

Causes.—The disease usually occurs from the fifth to the twentieth year. The most frequent predisposing cause is inherited syphilis or scrofula, and some authors attribute as high as 90 per cent. of the cases to these causes. It is certainly a fact that in the large majority of cases the so-called Hutchinson teeth are present. These consist essentially of a single broad notch in the cutting-edge of the tooth especially found in the upper central incisors. In addition to the teeth we usually find other evidences of inherited syphilis, such as the characteristic physiognomy, peculiar conformation of the skull (square forehead, prominent frontal eminences, depressed bridge of the nose). The child is apt to be thin, anemic and of stunted growth, with cicatrices at the angles of the mouth, and often more or less deaf.

Prognosis.—In the majority of cases the recovery will be nearly or entirely complete; that is, the haziness will disappear and vision will be restored to normal or nearly so. Cases accompanied by vascularity of the cornea are less favorable than those where no vessels appear in the cornea.

Complications.—There is a great tendency of the iris to become inflamed, and when it is, it is often overlooked on account of the haziness of the cornea. Cyclitis, choroiditis and opacities of the vitreous may also occur.

Treatment.—In a large majority of cases the use of the homeopathic remedy is all sufficient and gives decidedly better results than any other mode of treatment.

The diet should be nutritious and easily digestible, while the use of tonics and stimulants may be advisable. The eye should be protected from the light and wind. During repair fresh air and out-door exercise should be advised. In those cases where the infiltration is so dense that the iris cannot readily be watched, Atropin should be instilled to prevent involvement of the iris. In some extremely indolent cases good effect is obtained from the use of the *yellow oxide* ointment or the dusting of the eye with powdered Calomel. Hot fomentations have sometimes seemed beneficial in causing the development of new blood-vessels to hasten the absorption, and also in preventing the lymphoid infiltration.

Aurum mur.—Is especially important in all those cases in which the cause can be traced to hereditary syphilis. The subjective symptoms are not prominent and may be absent, though usually there is some photophobia, irritable condition of the eye and dull pain in and around the eye, which often seems deep in the bone.

Cannabis sat.—Interstitial inflammation of the cornea from hereditary syphilis. Cornea densely opaque and vascular. The photophobia is intense, and lachrymation profuse.

Hepar.—In scrofulous subjects. Cornea opaque and vascular, with deep ciliary injection, severe iritic pains, excessive photophobia, profuse lachrymation and great sensitiveness of the eyeball to touch.

Mercurius sol.—The ciliary injection, pain and iritic complication are well marked, as well as the nocturnal aggravation and general concomitant symptoms.

Calcarea phos., *Arsenicum*, *Apis*, *Baryta iod.*, *Kali mur.* and *Sepia* are often indicated.

OPACITIES OF THE CORNEA.—These are often classified according to their density as leucoma, macula, nebula, etc.—the leucoma being the most dense or non-transparent. The impairment in vision will be oftentimes surprisingly great from an almost imperceptible nebula over the pupil, while a dense leucoma at the periphery of the cornea will cause no loss of vision. Very sharp, careful scrutiny of the cornea with the oblique illumination is often necessary to recognize a very faint opacity, which may be the cause of more or less loss of vision.

Arcus Senilis or *Gerontoxon* is a light gray oval ring at the periphery of the cornea. It is perfectly smooth and more intense toward the limbus, from which it is separated by a narrow, transparent strip.

Sclerosis of the cornea is another form of opacity resulting from an infiltration of the cornea. This condition generally results from keratitis, episcleritis, etc.

Prognosis.—In recent opacities a gradual absorption may be expected, especially if occurring in a young subject. Central opacities may cause strabismus, or, if semi-transparent, may simulate myopia, as the patient will hold objects nearer to the eyes in order to obtain a clearer retinal image. Bilateral corneal opacities in young children may cause nystagmus.

Treatment.—If the opacity is recent and superficial and especially if present in children some benefit may result from the use of hot compresses, followed by the application of the yellow oxide of mercury ointment in the conjunctival sac and the massage of the cornea for a few minutes, repeated every day or two.

In an old, dense and large central opacity, an iridectomy opposite a transparent portion of the cornea is frequently advisable. When the opacity is very dense and disfiguring, it may, for cosmetic effect, be covered by *tattooing* with India ink.

Remedies such as *Aurum*, *Calc. carb.*, *Calc. iod.*, *Hepar*, *Kali bichr.*, must be prescribed upon the general symptoms of the patient.

STAPHYLOMA OF THE CORNEA is a bulging forward of the cornea, either in part or of the whole, and is due to perforation of the cornea with a prolapse of the iris and a large adhesion to the cornea. A central perforation, with no adhesion of the iris, will not cause staphyloma. Total staphyloma results from large perforations, such as are apt to be found in purulent or diphtheritic conjunctivitis or hypopyon keratitis, while the partial staphyloma is more apt to result in cases of pustular keratitis in children. Staphyloma is directly due to the glaucomatous symptoms resulting from the adhesions of the iris and cornea, which blocks up the filtration passages or excretory channels of the eye. The tension in staphyloma is usually slightly increased. A partial staphyloma may increase to an involvement of the entire cornea, or total. When the bulging has increased so as to protrude between the lids, its exposure is apt to produce inflammatory exacerbations, which cause a still greater increase in the staphyloma. Its shape is usually spherical and the sclera or whole anterior part of the eyeball may be involved. The appearance of a staphyloma is usually densely white or bluish and with large vessels coursing over it, or it may appear thinner and darker in color.

Treatment.—In partial staphyloma paracentesis, frequently repeated, may prevent its increasing, although, as a rule, iridectomy, which acts by diminishing the intraocular pressure, is better. When complete, and the vision destroyed, our aim should be to improve the appearance and relieve the pain by a removal of the protrusion. This may be done in several ways. *Abscission* is made by first separating the conjunctiva all around the cornea, nearly back to the equator of the eyeball. Four sutures of different colors are passed through the conjunctiva about three mm. from the margin of the wound. The protrusion is then cut off by transfixing it through the middle, and cutting outward, then seizing the end of the flap thus formed and removing the rest with scissors. The sutures are then tied and the eye closed without much loss of its contents or risk of bleeding. This operation is preferable to enucleation, because it furnishes a much better stump for the wearing of an artificial eye. The objections to it are the danger of setting up a severe inflammatory reaction or of causing a sympathetic inflammation of the other eye.

Enucleation of the Eye.—In this operation a pair of curved blunt-pointed scissors, speculum, fixation forceps and a squint hook are necessary. A general anesthetic should always be used. The conjunctiva is to be separated from the globe close to the cornea all around, and the capsule of Tenon dissected back. Then the superior rectus muscle is taken up on the squint hook and severed close to the globe; the other recti muscles may be divided as most convenient, and also the obliques before cutting the optic nerve. To divide the optic nerve the scissors should be inserted closed at the inner side and pushed back until coming in contact with it, when the blades are opened and the nerve severed. The eye should then be pushed forward with the scissors and the numerous small bands of adhesion, which are usually found, cut away. Immediately after cutting the nerve more or less hemorrhage is apt to occur, but usually is readily controlled, after which a thorough irrigation of the cavity with a 1–5000 solution of corrosive sublimate should be employed and a *firm*, *tight* compress bandage applied.

Evisceration or Exenteration of the eye, as removal of its contents is called, is done by excising the cornea at the limbus and removing the entire contents of the globe down to the sclerotic, either with a spatula, or, as performed by the late Dr. Liebold, with balls of picked lint, wiping out the vitreous, retina and choroid until perfectly clean. The cavity is thoroughly irrigated with a 1-5000 bi-chloride solution and the scleral wound drawn together with sutures. The principal value of this operation over enucleation is that it leaves a larger and better stump for the wearing of an artificial eye.

Artificial Eyes are made of both glass and celluloid and are of various sizes and colors. The eye should not be worn until from six to eight weeks after the removal of the globe, and then not worn continuously at first and always should be removed at night. The insertion of an eye is very easy and readily acquired by the patient. It is to be pushed beneath the upper lid and held there while the lower lid is brought over its lower edge. In its removal the lower lid is depressed and a probe inserted beneath the eye, which is brought forward and slips out from its own weight.

CONICAL CORNEA (*Keratoconus*).—Conical cornea is easily overlooked when but slight. In a marked case we notice that the centre of the cornea appears unusually bright and glistening, as though from a tear drop; but from a side view a decided prominence is at once seen. The conicity is usually in the centre, but may be found at the margin of the cornea. On examination with the ophthalmoscope by the direct method there is seen a central bright red spot, surrounding which is a dark zone, and again outside of this a red ring. The vessels of the fundus appear distorted and broken and the optic disc seems elongated. The vision is often greatly impaired, even in the slightest cases, owing to the eye having become myopic and from the astigmatism caused by the irregular curvature of the cornea. This astigmatism is too irregular to be corrected with glasses. The bulging is due to a thinning or diminution in the power of resistance of the cornea so that it yields to the normal intraocular tension. The condition usually commences between the ages of ten and thirty, generally attacks both eyes, is non-inflammatory and is most often found in young women. Its course is very slow and may become stationary at any point. Often the apex of the conical cornea is more or less opaque.

Treatment.—Glasses will usually give but little improvement, the stenopaic aperture or slit may sometimes be added with some further improvement in the vision. When there is a central opacity of the cone, an iridectomy will often be of value. Cauterization has been tried in numerous cases and in some with decided flattening of the conicity and some improvement of vision. An electrode of about the size of the head of a pin is applied to the apex of the cone and burns away a portion of the external surface of the cornea. Under antiseptic dressings there is but little reaction and the resulting opacity is but slight. This is generally followed by an iridectomy to form a new pupil opposite some clear portion of the cornea.

GLOBULAR CORNEA (*Keratoglobus*).—In this disease there is a general spherical distension of the cornea in all its diameters. Sometimes the protrusion becomes so great as to extend between the lids, which cannot close over it, giving a peculiar staring appearance to the eye (*buphthalmos*).

INJURIES OF THE CORNEA FROM FOREIGN BODIES, such as chips of iron, steel, wood, glass, etc., are of very frequent occurrence. When imbedded in the cornea they generally excite considerable reaction—the eye becomes red and painful, there is photophobia and lachrymation and the pupil may be somewhat contracted. They may set up an inflammation of the cornea or even the iris, and in old, enfeebled subjects, may result in considerable ulceration or slough of the cornea.

Treatment.—Foreign bodies in the cornea can usually be easily removed, after the instillation of cocaine, by the aid of a gouge without fixation of the eye, though if the patient be very nervous and the foreign body be deeply imbedded in the cornea it is better to use a stop speculum and fix the eye with a pair of forceps or employ an anesthetic. If the foreign body has penetrated the cornea and lies partly in the anterior chamber, a broad needle should be introduced behind it in order to prevent its being pushed backward in the attempt to extract it. Pieces of steel may often be removed with a strong magnet.

To Remove a Foreign Body.—The surgeon stands behind the patient, who is seated facing a good light; the left hand of the surgeon separates the lids and steadies the eyeball, the index finger grasping the margin of the upper lid and the middle finger the lower, making slight pressure backwards to prevent eversion of the lids. The gouge or spud scoops out the foreign body from above downward. The eye under cocaine suffers no pain. After the removal, if much inflammation, use *Aconite* and cold compresses.

WOUNDS OF THE CORNEA.—Small, clean cuts or perforations usually soon heal, with no trace of the injury remaining. The chief danger of penetrating wounds of the cornea is from injury or prolapse of the iris, or from injury to the lens, and, from either of these accidents, leads to a general inflammation of the whole eye (panophthalmitis). Bruises are very apt to excite suppuration.

Treatment.—Subdue the inflammatory symptoms by the use of *ice bags*, especially if the iris and other tissues have also been injured. Cold compresses of Aconite, Arnica, Calendula or Hamamelis may be employed locally; at the same time administering one or another, *usually Aconite*, internally. Atropin should be instilled into the eye if the injury is near the centre of the cornea or if the iris is involved. If the perforation is near the periphery of the cornea Eserin should be used.

CHAPTER XI.

DISEASES OF THE SCLERA.

Anatomy.—The sclerotic is a dense, tough, fibrous structure, continuous with the cornea, and by its strength, serves to maintain the form of the eyeball.

Its structure is similar to that of the cornea, excepting that it possesses blood-vessels and its fibres are coarser and less uniformly arranged. It also contains lymph channels, fixed and wandering cells, together with some pigment cells. The thickest portion of the sclera is at the posterior pole and thinnest just behind the insertion of the muscles. In front it is covered by a loose episcleral connective tissue, and over that by the conjunctiva. Posteriorly, about 2.5 mm. to the inner side of the antero-posterior axis of the globe, it is perforated by the optic nerve, whose sheath joins with the sclera. Surrounding the optic nerve the sclera is perforated by blood-vessels and nerves known as the posterior or short ciliary, which go to the choroid, ciliary, body and iris, and in front it is pierced by the anterior ciliary vessels. Near the equator four apertures transmit the *venæ vorticosæ* from the choroid.

EPISCLERITIS.—Inflammation of the subconjunctival connective tissue may occur alone or with scleritis. It appears as a circumscribed swelling near the edge of the cornea and close to the insertions of the muscles. The bulging is of a dusky red or a dull purple hue. The most frequent situation of episcleritis is over the external rectus muscle. It may be accompanied by both conjunctival and subconjunctival injection, which is apt to be localized. There is usually photophobia, lachrymation and ciliary neuralgia, with some dull heavy pains around the eye.

Episcleritis frequently resembles very closely a large phlyctenule of the conjunctiva. (For differential diagnosis see phlyctenular conjunctivitis.) The course of an episcleritis is long, usually lasting for weeks and is apt to recur again and again. There is never any ulceration in this disease, as they always disappear by resorption. It is most frequently found in adult females, and has often been found in those of a rheumatic diathesis. The *prognosis* is unfavorable as to the duration of the disease, but favorable as to the final outcome of vision.

The *treatment* of episcleritis and scleritis are practically the same and will be detailed after a few words upon the latter disease.

SCLERITIS (*Sclerotitis*).—Is an inflammation of the deeper layers of the sclera and is distinguished from an inflammation of the more superficial layers, episcleritis, by its tendency to extend to other parts of the eye. This condition appears as a general faint pinkish tint, due to injection of the superficial vessels of the sclera. There may also be present a conjunctival injection, which is distinguished from that of the sclera by being of a deeper red and movable over the pinkish hue of the scleral injection. As the inflammation increases the sclerotic assumes a deeper color. There is apt to be quite severe pain in scleritis and it is undoubtedly of a rheumatic or gouty origin. Females are more subject to this disease than males, and disturbances of menstruation seem to be an exciting cause. Inflammation of the sclera is apt to lead, from ultimate thinning and weakening of its tissue, to staphyloma of the sclera, which may be total, involving the whole anterior part of the eye, or it may be partial, confined to some one section.

As complications of this deep form of scleritis we may have a sclerotizing opacity of the cornea, an iritis or a choroiditis with opacities of the vitreous.

Treatment.—If there is great ciliary injection and pain, a solution of Atropin may be employed, but it is rarely necessary.

Thuja.—Great tenderness of the globe, intolerance of light and active inflammation, with a general cachectic condition, occurring in persons badly nourished, either scrofulous or syphilitic.

Sepia.—Especially in those cases dependent upon or associated with menstrual disturbances. The eyes feel fatigued when using them, a strained dragging sensation in the eyes. Everything gets black before the eyes during menstruation.

Mercurius.—Steady aching pain in the eye all the time, but worse at night; also usually some pain around the eye, especially if the iris has become involved.

Kalmia.—Sclera inflamed, vitreous filled with opacities, glimmering of light below one eye.

Aconite.—In the acute stage, if there are violent, aching, dragging, tearing, or burning pains in the eyeball with contracted pupil, photophobia and the characteristic reddish-blue circle around the cornea. The eye is usually quite sensitive to touch and feels hot and dry.

Aurum, Silicea and *Cinnabar* should also be thought of.

STAPHYLOMA OF THE SCLERA.—Bulging of the sclera may be either partial or complete. When partial, it is usually at the ciliary region where the sclera is weakened, and between the insertion of the muscles. Staphyloma usually results from an irido-choroiditis, accompanied by an increase of the intra-ocular tension; or, it may result from simply thinning of the sclera from inflammation, *sclerotico-choroiditis anterior*, without increased tension. If its course is very acute, we find conjunctival and sub-conjunctival injection, chemosis and intense ciliary neuralgia. The ciliary region is extremely sensitive to touch, the cornea and aqueous are hazy, the iris discolored and adhered to the lens, the vitreous is clouded with large shreds, tension increased, the vision and field of vision impaired. As the bulging increases it assumes a dusky, dirty-gray or bluish hue, due to the choroid shining through. The progress of the staphyloma is very slow and gradual. Inflammatory exacerbations come and go, each time increasing the staphyloma. When the bulging extends all around the sclera it is called *annular* staphyloma, and, when complete, may protrude so far as to be called *buphthalmos*.

Treatment.—We should endeavor to prevent this result by the use of those remedies given under scleritis, but if it seems to progress in spite of our remedies, an *iridectomy* must be made.

If the staphyloma has existed for some time, it may be abscised; if it be extensive, and sight is lost, enucleation is to be preferred.

INJURIES OF THE SCLERA.—In penetrating wounds there is diminished tension, and, if extensive, there is usually a prolapse of the iris, ciliary body or vitreous. Wounds accompanied by a prolapse of the iris are especially dangerous from their liability to cause an iridocyclitis and even sympathetic ophthalmia of the other eye. Wounds further back, causing escape of the vitreous, if slight, may heal without any serious consequences; but, if extensive, may result in inflammatory changes in the choroid, detachment of the retina, or a panophthalmitis with subsequent atrophy of the globe. Rupture of the sclera from a severe blow usually takes place parallel with the cornea and from two to five mm. posterior to it. There is usually a dislocation of the lens, which may be through the rupture and found underneath the conjunctiva, or, if the conjunctiva is also ruptured, it may be expelled wholly from the eye.

Treatment.—If any protrusion of the contents of the globe has occurred, it should be cut off and the edges of the wound approximated as closely as possible by the aid of a bandage, or the introduction of a fine suture. The patient should be kept quiet in bed with *ice-compresses*, and *Aconite* given internally.

If the wound, however, is extensive, especially if in the ciliary region, even though the vision is not wholly lost, enucleation is far the safer method of proceeding in order that all danger of sympathetic trouble in the other (healthy) eye may be taken away. In all cases in which a large portion of the globe has escaped and sight is irretrievably lost enucleation is necessary.

If there is a foreign body in the sclerotic it should be removed, but if it has penetrated the sclerotic and is within the eye, it is usually necessary to enucleate, although its extraction may be attempted if there has not been too much injury to the ciliary body. The Haab magnet has, of late, been used with great success for the removal of steel or iron from the interior of the eyeball.

CHAPTER XII.

DISEASES OF THE IRIS.

Anatomy.—The iris is the beautiful, colored contractile membrane which is seen through the transparent cornea. It is attached at its periphery to the sclera and is perforated at about its centre by a round opening, the pupil. It rests posteriorly on the capsule of the lens while its anterior surface is free. The iris is continuous with the ciliary body and choroid, and together they form the vascular tissue of the eye known as the *uveal tract*, which secretes the aqueous humor and nourishes the lens and the vitreous. Between the iris and the lens is a circular space known as the posterior chamber, while between the iris and the cornea is found the anterior chamber. Both anterior and posterior chambers contain the aqueous humor, in which fluid floats the iris. The anterior surface of the iris is lined with a layer of endothelial cells, while on the posterior surface is a thicker layer of cells containing much pigment and continuous with that of the ciliary body and choroid. The *substantia propria* consists of connective tissue fibres and cells, many of which, in dark eyes, contain pigment, and within this stroma are found the muscular fibres, blood-vessels, lymphatics and nerves. The *muscular fibres* are flat, found in bundles, and are of the unstriped variety. Some are arranged in curves about the pupil, nearer the posterior than the anterior surface, and constitute the *sphincter pupillæ*, while others, more deeply situated, run in a radial direction from the centre to the circumference and are called the *dilator pupillæ.*

The blood supply of the iris is derived from the *circulus iridis major*, which is formed by two long posterior ciliary arteries uniting at the ciliary regions with the branches of the anterior ciliary arteries; these then give off branches that pass radially toward the pupil, where they form by anastomoses another ring called the *circulus iridis minor.*

The nerves of the iris are very numerous and are derived from the third, fifth and sympathetic, through the ciliary ganglion.

FUNCTION OF THE IRIS.—The iris serves as a curtain to regulate the amount of light entering the eye and acts as an aid to accommodation. This it does by contraction and dilatation of the pupil.

The pupil varies, its size being usually larger in children, in myopes, and in nervous and excitable people. In health it contracts as the eyes converge and dilates in distant vision. It contracts in bright light and dilates as the light diminishes. The pupil should be of the same size in both eyes and should respond alike to any change of light to one eye alone.

The reaction of the pupil is tested by exposing the eye to an alternate increase and decrease in the amount of light falling upon the eye. The direct contraction is that of the eye exposed to the illumination. The indirect is seen by throwing a light into one eye and observing the contraction of the pupil of the other eye. Indirect contraction is due to the light stimulus in one eye being carried by the optic nerve to *both* optic tracts and to the nucleus of the third nerve of each side. The contraction upon convergence is noted by having the patient fix an object held in the medium line several inches from the eyes and then a distant object.

THE REACTION OF THE PUPIL IN DISEASE.— Blindness in one eye prevents direct reaction of that eye but indirect reaction is preserved.

Blindness must be absolute to prevent reaction. In blindness where the pupil still reacts well to light the lesion is in the occipital lobe; if all reaction is lost the lesion is in the optic nerve or retina, in the optic tract, or at the base of the brain. The absence of contraction upon convergence indicates usually a paralysis of the third nerve.

The *Argyll-Robertson* pupil is one that does not react to light, though vision may be perfect, but does contract upon convergence. It may be present in one or both eyes, and is frequently a symptom of locomotor ataxia or general paralysis of the insane. Myosis often accompanies this condition and care must be taken that it is not due to a rigidity of the iris or posterior synechia.

MYDRIASIS is a persistent dilatation of the pupil which may be found in one or both eyes. It may be present from irritative causes as helminthiasis, in spinal or cerebral irritation, in acute mania or melancholia, or from hysteria, or sexual irritation. When due to paralytic causes, it may result from diseased processes at the base of the brain, intra-ocular tumors where there is pressure on the ciliary nerves, in glaucoma, diphtheria, syphilis, etc., or it may occur from injuries, simple colds or draughts of air. Atropin, Dubosin, Homatropin, Scopolamin and many other drugs will cause mydriasis by paralyzing the terminal filaments of the third nerve. When due to irritation it is through stimulation of the sympathetic.

MYOSIS is a persistent contraction of the pupil and like mydriasis occurs in so many different conditions that there is no great special significance in either. It may be dependent upon some irritation or inflammation of the eye, in early stages of inflammation of the brain or its meninges, and when it changes to mydriasis it is a serious prognostic sign indicating the stage of depression with paralysis of the third nerve. It also occurs in early stages of apoplexy, intra-cranial tumors, hysteria or epilepsy, and in tobacco or alcoholic amblyopia.

Paralytic myosis occurs in spinal lesions above the dorsal vertebræ, in general paralysis of the insane, and is a prognostic sign of general paralysis approaching when it follows the dilated pupil of acute mania.

Spinal myosis is nearly always bilateral and may be preceded or accompanied by atrophy of the optic nerve and contraction of the field of vision.

Myosis is also caused by Eserin, Pilocarpin and other drugs.

HIPPUS is a spasmodic pupillary movement irrespective of light or accommodation. There is an alternate contraction and dilatation of the pupil which may occur in nystagmus, in multiple sclerosis, acute meningitis, after epileptic attacks, in hysterical spasms, etc.

HYPEREMIA OF THE IRIS is diagnosed by the ciliary injection, a fine pinkish or rosy zone surrounding the cornea; by a change in the color of the iris, it loses its normal lustre and brilliance, becoming of a dull hazy appearance; and by a sluggish contracted pupil, there are no adhesions, but it is simply slow of action. The discoloration of the iris may not be noticed in brown eyes but in gray or blue eyes it causes a greenish hue that is quite apparent.

Pronounced hyperemia indicates inflammation but we may have it present in a light degree as the result of other inflammations of the eye, from the overuse of the eyes, foreign body in the cornea, etc. Its treatment is that of iritis.

IRITIS.—Inflammation of the iris, of whatever form or variety, presents certain characteristic features which are found in varying degrees in the different pathological or clinical classifications. One form of iritis may change to another as a serous to a plastic. Posterior synechia, the diagnostic sign of plastic iritis may occur in any form. The pathological varieties of iritis are, serous, plastic and purulent or parenchymatous.

Iritis is more frequently classified, clinically, according to its cause as syphilitic, rheumatic, serous and less frequently as gouty, gonorrheal, diabetic, tubercular, etc.

Symptoms.—Ciliary neuralgia is the most characteristic symptom. This pain which is generally very severe may be confined in or around the eye, extend to the forehead or temples, or may involve the whole head. The pain of iritis is always worse at night, usually in damp weather, and often increased by cold and relieved by warmth. The pain as a rule indicates the severity of the attack. In some cases of chronic or serous iritis the pain is quite absent.

The ciliary, or pericorneal, injection ranks with the severe pain as a diagnostic sign of iritis. This peculiar congestion of the eye always indicates iritis, glaucoma or some other serous inflammation. It consists of numerous very fine, deep vessels extending from the corneal margin in an almost straight course directly backwards and gives the appearance described as a rosy zone.

The conjunctival injection is of much less importance and is indicative of an inflammation of the outer coats of the eye. In this the vessels are far less numerous, more superficial, larger and more tortuous in their course. They are seen overlaying the ciliary injection when both forms are present.

The breadth and intensity of the pericorneal injection is, like the amount of pain, a good indication as to the severity of the iritis.

Discoloration of the iris, due to congestion, is always present and is seen upon comparing with the healthy eye; a blue or gray iris becomes a green, and a black or brown iris becomes of a reddish-brown color.

The iris loses its normal, glassy shining appearance and assumes a dull, hazy look.

The pupil is sluggish and contracted. Photophobia and lachrymation are well marked. Dimness of vision is often complained of and may be due to exudation, cloudiness of the aqueous or to congestion of the optic nerve or retina. The lids may be red and puffy. The conjunctiva may rarely be chemosed.

Posterior synechiæ, or adhesions of the iris to the lens capsule, are usually present, and are recognized by irregularities of the pupil seen when attempting dilatation with a mydriatic. These adhesions form one of the chief and most serious complications of iritis. When once formed they interfere with the mobility of the pupil and render subsequent attacks more liable, with greater probability of further adhesions. The pupil may be partially or completely closed by the exudation, in this way forming exclusion or occlusion of the pupil.

Course.—In acute cases iritis will run its course in about two to six weeks. A typical case will commence with marked redness, lachrymation and some pain. These symptoms rapidly increase so that at the end of the first week pain is very excessive in the eye and head, and the redness is intense, even chemosis in some cases. If it reaches this stage before active treatment is commenced it may remain about stationary for two or three weeks. Then there will be a gradual subsidence for a week or two until the eye has become white again. The chronic form of iritis lasts much longer because apt to be overlooked, as inflammatory symptoms and pain may be very slight or entirely absent. The only indications in chronic iritis may be very slight pericorneal redness and lachrymation with posterior synechiæ.

Recurrent attacks of iritis are very frequent, especially in the syphilitic and rheumatic forms and particularly where old adhesions are present.

Causes.—Usually in adults from the 20th to 45th year. May occur in one or both eyes and is more frequently found in men. Syphilis probably furnishes from 60 to 75 per cent. of the cases. It also occurs in scrofula, gout, gonorrhea, diabetes and other severe constitutional diseases. It frequently occurs from injuries, such as cataract operations, foreign bodies, etc. May be secondary from other diseases of the eye, and is often attributed to colds and overuse of the eyes.

Prognosis.—This depends upon the stage of the disease and the treatment followed. If seen before adhesions are formed we should have perfect recovery; if after posterior synechiæ are present there may be more or less interference with vision, and relapses, which still further injure the eye, are more prone to occur.

Complications are chiefly secondary involvement of the ciliary body and choroid, and would be suspected when the impairment of vision increases, the eye becomes extremely sensitive to touch, increased redness, and when the ophthalmoscope reveals opacities of the vitreous. The tension should also be watched as glaucoma is liable to occur, especially where there has been total posterior synechiæ. Capsular cataract may result from adhesions of the iris to lens capsule.

Differential Diagnosis.—As iritis often very closely resembles acute glaucoma the greatest care must be taken to accurately diagnose the case. *This is of the most vital importance, because the correct treatment of the two diseases is diametrically opposed.*

In *iritis* there is a *gradual onset* of the disease, usually occurs from the 20th to 45th year and is *especially due to syphilis and rheumatism.* There is conjunctival and pericorneal redness, *iris discolored*, *pupils contracted* and usually posterior synechiæ. There *is severe pain in the eye and head which is worse at night* and in damp weather. Eye sensitive to touch and vision somewhat impaired.

In *glaucoma*, usually history of patients frequently increasing the strength of their glasses owing to premature recession of near point, and will oftentimes have noticed for some while before a *rainbow of colors encircling a light.* *Onset is sudden*, usually at night, sets in with severe pain, often accompanied by vomiting, fever, and general prostration. Onset usually caused by some sudden excitement or grief. Occurs especially in old age, rarely under thirty-five and usually in but one eye. There is both conjunctival and pericorneal redness. *Cornea hazy, pupil dilated, greenish reflex from pupil, intense pain in the eye and head. Eyeball is hard*, somewhat sensitive to touch and vision impaired. Ophthalmoscopic examination shows *excavation of the optic disc.*

In *keratitis* there is usually a pericorneal redness and contracted pupil, but the pupil readily dilates and the corneal lesion should be seen by careful examination.

In *conjunctivitis* the redness is of the conjunctival vessels and the pupil usually reacts freely.

In *neuralgia* there is no redness of the eye and the presence of inflammation is always indicative of some serious lesion.

SYPHILITIC IRITIS is one of the most frequent varieties and occurs usually as one of the latest symptoms of secondary manifestation of acquired syphilis, or it rarely may occur, most generally about puberty, from inherited syphilis. The presence of more or less prominent yellowish-red or dirty brown nodules (gummy tumors) renders the diagnosis, as due to syphilis, positive. These tumors vary in size from that of a head of a pin to a size sufficient to fill the anterior chamber and may even break through at the border of the cornea and become external. They are usually but little larger than the head of a pin and are found at the pupillary or peripheral edge of the iris.

Syphilitic iritis has all the characteristic symptoms already described, but is apt to be more tedious in its course. Generally both eyes are affected; and the adhesions in this form of iritis are comparatively broad and unyielding.

RHEUMATIC IRITIS. — Some authors say that the rheumatic form of iritis is the most common. It is especially found in cases of acute rheumatism particularly when articular. Attacks of this form of iritis are apt to be more severe, of a much longer duration and relapses are especially prone to appear.

SPONGY IRITIS.—A clinical classification made when there is found in the anterior chamber a yellowish-white spongy looking mass, which may fill the whole chamber. It is due to hemorrhage into the stroma of the iris with exudation of the plasma into the anterior chamber. During the process of absorption of this mass, which always begins in the parts nearest the cornea, it may appear, and has sometimes been mistaken for, an opaque lens dislocated into the anterior chamber.

PARENCHYMATOUS IRITIS (*Suppurative*, *Purulent* or *Traumatic Iritis*).—In this form there is much greater swelling of the iris with purulent exudation on the surface. Large blood-vessels may be seen crossing the iris and occlusion of the pupil forms rapidly. Occurs especially from injuries and after operations, as cataract extraction. Commences with edema of the lids, lachrymation, chemosis, hypopyon, and swelling of the iris. The severity of the attack depends upon the presence of septic matter, or a foreign body within the eye. It often terminates in a general suppuration of the eye.

SEROUS IRITIS is where the serous element in the exudation predominates over the plastic and prevents the formation of adhesions, or at the most but very slight adhesions. Usually associated with serous inflammation of the ciliary body or choroid and often causes a slight infiltration into the cornea.

It is especially characterized by deposits upon the posterior surface of the cornea which gives it a dotted appearance usually of a pyramidal shape with the base at the periphery and the apex at the centre of the cornea and changing with the position of the head. Contrary to all other forms of iritis the pupil may be slightly dilated. The general symptoms of iritis are very slight and but few inflammatory signs.

In the treatment of serous iritis the tension of the eye must be watched, especially when using mydriatics, as occasionally glaucomatous symptoms have followed.

Treatment.—The first and most important thing to be done in every case of iritis is to *secure a full dilatation of the pupil as quickly as possible.* This point cannot be too strongly emphasized as the whole future of the case and the function of the eye itself depends upon it.

Atropin in a one per cent. solution is the most generally used mydriatic, but *the pupil must be widely dilated*, if possible, and to secure this, one must not hesitate to use much stronger solutions, even the crude drug if necessary. If the patient can be closely watched for Atropin poisoning a one per cent. solution should be instilled every ten minutes for an hour or until the pupil is well dilated. To avoid poisoning the head should be held to the side of the affected eye, the drops instilled into the outer corner, and firm pressure made for about a minute after each instillation, upon the lachrymal puncta. After having secured full dilatation of the pupil it must be maintained until all redness has left the eye. In severe cases the Atropin may have to be used every hour for days, in milder cases every two or three hours may be sufficient to keep the pupil at the maximum dilatation and as the disease subsides it may be reduced to two or three instillations per day. Dryness of the throat or flushing of the face will indicate that the Atropin must be used less frequently, or perhaps discontinued entirely. Occasionally Atropin acts as an irritant to the eye and causes marked swelling and redness of the lids, when some other mydriatic, viz., Duboisin, Hyoscyamin, Daturin or Scopolamin should be substituted, but should be used about one-half the strength of Atropin.

Other local treatment of much value in relieving the pain of iritis should be employed. First, bathing the eye in very hot water for a few minutes before the instillation of the mydriatic serves not only to relieve the pain, but by softening the tissues of the eyeball seems to aid in getting greater action of the drug.

Warmth is one of the most important aids in the treatment. Dry warmth by covering the eye and side of the head with a large, thick cotton pad is the best because giving a constant and uniform heat.

Hot Salt Bags will often relieve the severe pains of iritis. Use a small linen bag about three inches square, one half full of fine table salt heated in an oven.

Cold Applications.—The ice-bag can be used with benefit in traumatic iritis, sometimes in rheumatic and rarely in syphilitic iritis. My indications for the ice-bag have been where there is an unusual amount of conjunctivitis present. In using ice the cornea must be watched and its use discontinued upon the appearance of any haziness of the cornea which it may produce by affecting the nutrition of the cornea.

General Points.—Remove any exciting cause that may be present, as a foreign body in the conjunctiva, cornea, etc. If due to a swollen or dislocated lens it should be removed. If sympathetic and the eye causing the sympathetic involvement of the good eye *has already been destroyed* it should be at once removed.

Iritis is often treated without confining the patient to the house, but it is always better to do so, and if severe the patient should be kept in a darkened room and in bed, in order that perfect rest may be had both from the irritation of light and from muscular movements. Alcohol and stimulating foods are to be avoided and as a rule a low diet unless the patient is too much debilitated.

Operations are occasionally performed when there is increased tension, as may occur in serous iritis. Repeated paracentesis is preferable. Operative measures are as a rule, however, only resorted to after the inflammation has subsided, for the purpose of remedying the sequela.

REMEDIES IN IRITIS.

Mercurius.—The symptomatology of *Mercury* forms a typical picture of iritis and in its various combinations is our "sheet-anchor" in the treatment of all forms of iritis, especially syphilitic. The pains are usually severe in and around the eyes, and in the forehead and temples.

The *Mercurius* pains are always worse at night and in damp weather, in this respect corresponding very closely to the disease. There is great sensitiveness to light. Iris discolored, pupil contracted, great tendency to the formation of adhesions, ciliary injection marked and all the characteristic symptoms of iritis found under this drug.

Kali iod.—An important remedy in syphilitic iritis, especially after mercurialization and if the secondary eruption on the skin is present. The special indications are not marked, though the inflammation is usually of high degree. It often relieves when given in large doses after the potencies have failed.

Aurum.—Chiefly serviceable in syphilitic iritis and after over-dosing with *Mercury* or *Potash.* There is much pain, which seems to be deep in the bones surrounding the eye; the pressing pain is usually from above downward and from without inward, aggravated on touch.

Cinnabaris.—Of great value in syphilitic iritis if gummata are present. The characteristic pain commences at the inner canthus and extends across the brows or even passes around the eye. Like *Mercury*, the nocturnal aggravation is usually marked.

Hepar.—Especially serviceable if the inflammation has extended to the neighboring tissues, cornea (kerato-iritis) and ciliary body (irido-cyclitis) and if there is pus in the anterior chamber (hypopyon). The pains are in the eye, ameliorated by warmth and aggravated by motion. The eye is very tender to the touch. The patient feels chilly and wants to keep warmly covered.

Rhus tox.—Idiopathic or rheumatic iritis, if caused by exposure to wet, or if found in a rheumatic patient.

Suppurative iritis, particularly if of traumatic origin, as after cataract extraction. The lids are edematously swollen, spasmodically closed, and, upon opening them, a profuse gush of tears takes place. There is chemosis and the pains are in and around the eye and worse at night.

Bryonia.—In serous iritis and from exposure to cold, especially if occurring with a rheumatic diathesis. The pains may be sharp and shooting in the eyes, extending through into the head, or down into the face, or there may be a sensation of soreness and aching in and around the ball. Pain, as if the eyes were being forced out of the socket. The seat of pain often becomes sore to touch.

Asafetida.—Especially indicated in the syphilitic variety. The pains are severe in and around the eye, and extend usually from within outward and relieved by rest and pressure. (Reverse of *Aurum*).

Thuja.—Syphilitic iritis, with gummata on the iris. Large wart-like excrescences on the iris, with severe, sharp, sticking pains in the eye, aggravated at night and ameliorated by warmth.

Cedron.—This remedy is particularly of value in relieving the severe ciliary neuralgia observed in iritis, if supra-orbital.

China.—Iritis dependent upon malaria. The pains are variable, but have a marked periodicity. The muriate of quinine, in appreciable doses, will often relieve severity of the pain, especially when of an intermittent type and accompanied by chills and fever.

Nitric acid.—Chronic syphilitic iritis of a low degree, with very little or no nightly pain.

Arsenicum.—Iritis, with periodic burning pains, worse at night, after midnight, ameliorated by warm applications. Frequently indicated in serous iritis.

Aconite.—In the very first stage, or, in a sudden reappearance, especially when due to an exposure to a cold draught of air. It is the most commonly indicated remedy in traumatic iritis. The ciliary injection is usually marked, great heat, burning and dryness in the eyes.

Arnica.—In traumatic iritis and some cases due to rheumatism this remedy is of value.

Belladonna.—Early stages of iritis, caused from a cold; or chronic plastic iritis, following cataract extraction, with much redness and severe throbbing pain in the eye and head.

Clematis.—By some, this drug is considered to be as frequently called for as *Mercury*, in iritis. The pains are similar, but there is usually much heat and dryness in the eye and great sensitiveness to cold air.

Spigelia.—Rheumatic iritis, if the pains are sharp and shooting both in and around the eye, especially if they seem to radiate from one point.

Sulphur.—Iritis, particularly if chronic. The pains are usually of a sharp, sticking character, worse at night and toward morning.

Terebinth.—Rheumatic iritis with intense pains in the eyes and head. Pain in the back and dark urine will be present.

The following remedies have also been employed in occasional cases with favorable results: *Arg. nit.*, *Crot. tig.*, *Nux vom.*, *Prunus sp.*, *Puls.*, *Sil.*, *Staph.* and *Zinc.*

TUMORS OF THE IRIS.—Both simple and malignant tumors are met with in the iris.

CYSTS, both epidermoid and serous, are in the large majority of instances due to traumatism. The epidermoid is usually the result of a penetrating wound, by which one of the cilia is carried into the iris. The appearance is that of a yellow, opaque tumor, and it may undergo a fatty degeneration. The serous cyst is merely distended iris tissue, which may become so thin as to be simply a structureless membrane. The appearance is that of a grayish-white or translucent tumor and its contents are similar to the aqueous humor.

The treatment consists of excising them as early as possible, and care should be taken not to rupture the cyst wall during removal.

MELANOMA is an extremely rare form of tumor affecting the iris. It appears as a small black tumor and should be excised.

GRANULOMA may very rarely appear in children as a pale red or yellow vascular tumor. They may also occur from a prolapse of the iris or after operations.

SARCOMA are very rarely found occurring primarily in the iris. The eye should be enucleated.

TUBERCLES appear chiefly in children and most frequently at the periphery of the iris and are accompanied by more or less inflammation. The treatment is to excise by an iridectomy.

IRIDODONESIS.—Tremulousness of the iris is dependent upon loss of support of the iris and is usually the result of a partial or total dislocation or absence of the lens.

IRIDONCOSIS.—Atrophy of the iris is the result of inflammation, usually a chronic parenchymatous iritis and consists of a fatty degeneration.

HYPEMIA.—Blood in the anterior chamber is usually of traumatic origin, although it may be spontaneous, as a result of some intra-ocular inflammation, or iritis. It may be but slight, or sufficient to entirely fill the anterior chamber, and is usually rapidly absorbed by the application of a compress bandage and the internal administration of *Arn.*, *Aurum*, *Ham.* or *Ledum.*

COLOBOMA OF THE IRIS.—Congenital absence, due to an arrest of development of a part of the iris, of either one or both eyes, is not uncommon. It may extend to the periphery or not, and is usually downward, or downward and inward, and may be of various shapes.

IRIDEREMIA (*Aniridia*).—Absence of the iris is usually total and in both eyes. When complete we may be able to see the ciliary processes. The lens usually becomes opaque, vision is decreased and nystagmus often accompanies it.

PERSISTENT PUPILLARY MEMBRANE consists of the presence of two or three fibres running across the pupil which are attached on the anterior surface of the iris and external to the sphincter. During the greater part of intra-uterine life the pupillary membrane stretches across the pupil, and in normal eyes it remains permanent after birth only in that part which covers the iris, whose endothelial layer it becomes.

HETEROCHROMA is the term applied to variations in the color of the iris. In one eye the iris may be black or brown and in the other blue, or the two colors may exist in different sections of the same iris.

CORECTOPIA, an anomalous position of the pupil. *Diplokoria*, double pupil, and *polycoria*, many pupils, are all congenital anomalies which are sometimes met with.

OPERATIONS ON THE IRIS.—*Iridectomy.*—This operation, consisting in the excision of a portion of the iris, is the one most frequently made for both therapeutic and optical measures. It is indicated for therapeutic purposes in glaucoma, staphyloma, posterior synechiæ and sometimes may be of value in obstinate cases of recurrent iritis. It is also indicated in tumors of the iris or for foreign bodies in the iris and is frequently performed preliminary to cataract extraction. For optical purposes it may be indicated in opacity of the cornea, occlusion of the pupil, central opacity or dislocation of the lens and in cataract extraction. Iridectomy, when made for visual purposes, should of course be made where there is the least opacity of the cornea and lens, preferably below and a little to the inner side, if possible. When made for therapeutical purposes it is preferably above, that the upper lid may cover the deformity as much as possible. The size of the iridectomy, when made for optical purposes, should be small, and large when made as a therapeutical measure.

After cocaine anesthesia the eyelids are kept open with the speculum and the eye steadied by a firm hold with the fixation forceps directly opposite the point at which the incision is to be made. The keratome is then inserted in the sclerotic at the cornea-scleral margin obliquely and in such a direction that, if continued, it would wound the iris and lens; but, as soon as the point is seen in the anterior chamber, the handle is depressed so as to bring the blade into a plane anterior and parallel to that of the iris and the blade is pushed forward until an external wound of sufficient size has been attained. The keratome is now to be slowly withdrawn, with its apex toward the cornea and well away from the iris and lens. The aqueous escapes with the withdrawal of the knife and should be allowed to pass off slowly. If the iris is washed out with the aqueous it is seized and cut off, if not the iris forceps are entered, closed, into the anterior chamber, opened, and the iris seized near its pupillary edge, drawn out and cut off. Care should be taken to see that the cut edges of the iris go back into place, as none of the iris should be allowed to remain in the wound. The eye is then closed and a bandage applied.

The accidents from Iridectomy are, first, from an injury of the lens by the keratome. This is a very serious accident which will be followed by partial or complete cataract and possibly glaucoma from swelling of the lens. Sometimes the keratome will enter the layers of the cornea instead of the anterior chamber when making the incision, due to its being held too obliquely. When this is discovered the instrument should be withdrawn and a fresh incision made. Hemorrhage into the anterior chamber is of no importance. Hemorrhage into the fundus of the eye is apt to occur in glaucoma and is of serious import. It results from a too rapid escape of the aqueous on the withdrawal of the keratome.

Iridotomy (*Iritomy*) consists in the formation of an artificial pupil by simple incision of the iris. It is only occasionally adopted, in cases of absence of the lens from injury or after cataract extraction. It is best made after De Wecker's method; a vertical incision about 3 mm. long is made in the cornea about the same distance from its margin with a keratome. De Wecker's forceps-scissors are then entered, closed, into the anterior chamber. The blades are opened and the sharp point of one is forced through the iris; by closing the blades the tightly stretched iris-fibres are cut through and from their retraction a central clear pupil is formed.

Iridodialysis is a tearing away of the periphery of the iris. This operation is rarely done and only when the extreme margin of the cornea is the only clear portion.

Iridavulsion.—Removal of the entire iris by tearing it from its periphery has been performed.

Corelysis.—The breaking of pupillary adhesions by the hook or toothless forceps has not proved a success.

CHAPTER XIII.

DISEASES OF THE CILIARY BODY.

Anatomy.—The ciliary body is that part of the uveal tract extending from the periphery of the iris to the choroid, and consists of the ciliary processes and ciliary muscle.

The *Ciliary Processes*, some seventy or eighty in number, are composed of a connective tissue stroma, of blood-vessels arranged in convolutions or folds, and overlaying these a densely pigmented layer. The tips of the ciliary processes lie a little in front of the edge of the lens, but are not in contact with it. From the posterior surface extends a transparent structure called the zonule of Zinn or suspensory ligament of the lens, which splits up to go to each surface of the lens, leaving a small triangular space called the canal of Petit. Through this structure transfusion from the vitreous to the aqueous humor takes place.

The *Ciliary Muscle* is composed of three sets of unstriped fibres: The meridional, running paralel to the sclerotic; the circular, forming a ring parallel to the cornea; and the radiating fibres.

The circular fibres of the ciliary muscle exert a pressure upon the edge of the lens, by means of which the latter becomes thicker and thus are the ones by which the act of accommodation is chiefly caused.

The vessels supplying the ciliary body are the posterior and anterior ciliary. The nerves are from the ciliary.

CYCLITIS.—Inflammation of the ciliary body is very rarely found uncomplicated with other diseases and usually, except when caused by wounds, is an extension of a choroiditis, or iritis. When the inflammation commences in the ciliary body it usually extends to these other parts, and in fact the iris is always more or less involved. The early recognition of cyclitis is essential on account of the danger to vision. The distinction between cyclitis and iritis is not an easy one, and it is necessary, therefore, to search carefully for the characteristic signs, which are, the extreme sensitiveness of the eye to touch, cloudiness of the vitreous and the change in the tension, which is first increased and later decreased. Cyclitis may occur as either a plastic, serous or purulent inflammation.

PLASTIC CYCLITIS.—**Pathology.**—The pathological changes are the same as those found in plastic inflammation of the iris, viz.: Hyperemia, swelling of the stroma cells, accumulations of wandering cells and an exudation of an amorphous mass, especially on the inner surface of the ciliary body. The exudation may extend to the iris, into the posterior and anterior chambers and also into the vitreous. The retina and choroid later may become involved, the retina detached and blindness result.

Symptoms.—There is ciliary injection and chemosis. The iris may be discolored and the pupil contracted, but there are no synechiæ, unless the iris is involved. Pain is usually a prominent symptom; it is generally quite severe in and around the eye. The most characteristic symptom is the *extreme sensitiveness of the eye to touch.* There may or may not be haziness of the aqueous, but the haziness of the vitreous is almost invariably present in the early stages, appearing on weak illumination like fine dust floating in the anterior part of the vitreous. The anterior chamber may be deepened. There is a rapid loss of vision and the accommodation is impaired. The tension may be either increased, decreased, or normal.

SEROUS CYCLITIS.—In this we have the same pathological changes as in serous iritis, and it is invariably accompanied by serous infiltration of other parts of the uveal tract. The symptoms are the same as just described, but less severe. The anterior chamber is deep, aqueous cloudy, and minute opacities are found in the vitreous. The tension, however, in serous cyclitis is apt to be increased and the pupil is usually dilated. It is especially found in young adults, is chronic in its course, liable to relapses, and is apt to involve the other eye.

PURULENT CYCLITIS. — In this there is a very marked lymphoid infiltration. The pus will extend into the aqueous humor, forming an hypopyon, which in purulent cyclitis may come and go very quickly. The disease, as a rule, passes over into panophthalmitis, in which there is a suppuration of the whole eyeball with subsequent atrophy. In sub-acute cases we may find a diminished tension, but there is generally increased tension. All the symptoms of the plastic form are present in this, and even of a higher degree.

Causes.—Cyclitis most frequently results from some form of injury, as in contusions of the eye or penetrating wounds in the ciliary region; after cataract operations where the incision was far back in the sclera; from dislocation or swelling of the lens from rupture of its capsule. The purulent form often results from septic emboli after pyemia, septicemia, etc. It chiefly occurs as secondary to inflammations of the iris or choroid.

Prognosis is most unfavorable in the purulent form, as it generally leads to suppuration of the entire eye. In the plastic form the prognosis is also unfavorable, because from its pathological changes, the vitreous loses its nutrition, becomes fluid, the retina detached, lens cataractous and the eyeball becomes atrophied.

Treatment should first be directed to the cause. If dependent upon a foreign body, it may be removed by the magnet; if due to a dislocation or swelling of the lens, remove it; if there is a wound with a prolapse of the iris, it should be drawn out and cut off and a compress bandage applied.

The treatment of inflammation in this portion of the uveal tract will depend almost exclusively upon internal medication. The eye must be kept warm, as in iritis, and Atropin may be necessary, as the iris is liable to become involved, but must be used with caution from the danger of increased tension. Special indications for remedies are to be found under Iritis.

INJURIES IMPLICATING THE CILIARY REGION are not only dangerous on account of inflammatory complications, but as a cause of sympathetic ophthalmia. Simple incised wounds may readily unite by keeping the eye at rest, or it may be necessary to use a fine suture, which should be inserted from within outward in both edges of the wound. Extensive injuries in this region will usually necessitate enucleation, though under certain circumstances the eye may be preserved, providing the patient is intelligent and will attend to the first unfavorable symptoms which may arise. Foreign bodies must be removed, if it is possible without too much injury to the tissues, or the eye must be sacrificed.

PARALYSIS OF THE ACCOMMODATION.—This may be either partial or complete, and the cause may be either local or general. If but one eye is affected, the cause is more apt to be local, affecting the third nerve in some part of its course, and the primary cause may be syphilis. Some injury of the eye or orbit may cause it, through some reflex influence, as may also some irritation of the fifth nerve, as in decayed teeth, etc. Exposure to draughts of air may also cause a one-sided paralysis of the accommodation. When the paresis affects the ciliary muscle of both eyes the cause is more apt to be general and often from some constitutional disorder. The most frequent cause is diphtheria and comes on usually during the convalescence or some time after. Paralysis of the accommodation is also seen after fevers, such as typhoid and recurrent fever. It also occurs in diabetes, articular rheumatism, locomotor ataxia, after debilitating excesses, as masturbation, sexual indulgence, etc. It is sometimes found due to uterine disease and from syphilis. Exposure to draught is a very frequent cause, and it has often been seen following la grippe. It is also present with paralysis of the external muscles in total paralysis of the third nerve.

The diagnosis depends upon loss of power of accommodation and dilatation of the pupil, though there may be a paresis of accommodation without mydriasis.

Prognosis is, as a rule, favorable, for as the majority of cases result from diphtheria, fevers, etc., the proper treatment will effect a relief. It may, however, be the forerunner of some grave general condition of serious import to the life of the patient, as, for example, when due to diabetes, to some obscure cerebral or spinal disease, etc.

Treatment.—The cause of the paralysis must be sought out and given due consideration in the treatment. The use locally of Eserin or Pilocarpin, of sufficient strength to slightly contract the pupil and stimulate the accommodation, is of great value.

Galvanism should also be employed, using from two to five milliamperes, with the positive pole applied to the base of the occiput and the negative over the closed lids.

The use of the appropriate remedy will also be of much service, and attention is especially directed to *Acon.*, *Caust.*, *Gels.* and *Physostig.*

SPASM OF THE ACCOMMODATION.—Spasm usually affects both eyes in an equal degree. It causes a decrease of the hypermetropia and an increase of the existing myopia and produces in emmetropia an apparent myopia. It may produce an apparent astigmatism or conceal a real one. Patients will have tired, strained feelings of the eyes together with headaches upon using the eyes, and objects are held closer to the eye than usual. Spasm of the accommodation is frequently found in children from the strain occasioned by use of the eyes. The condition occurs most frequently among asthenic subjects and more especially among young girls. The diagnosis of spasm depends upon a comparison of the apparent refraction with that which is real, as determined by an examination under the influence of a mydriatic.

Treatment.—In aggravated cases the regular and prolonged use of Atropin or the constant use of convex glasses may be necessary, but usually internal medication, with rest of the eyes for near work and correction of the ametropia, will relieve.

Jaborandi.—In spasm of the accommodation, or irritability of the ciliary muscle, there is no remedy so frequently useful as this. Everything at a distance is blurred without concave glasses, though near objects are seen distinctly. The vision may be constantly changing. Nausea or vertigo on using the eyes.

Eserine.—Of value in young hyperopes of slight degree, associated with headache and general asthenopic symptoms.

Physostigma ven.—Spasmodic action of the ciliary muscle. There are also generally to be seen twitchings in the lids and around the eyes.

Agaricus.—If associated with spasm of the lids or general chorea. Twitchings of the eyelids.

Lilium tig., *Nux*, *Puls.* and *Sulph.* have also been used with benefit.

CHAPTER XIV.

SYMPATHETIC OPHTHALMIA.

Sympathetic ophthalmia is a term applied to an affection of one eye as a result of disease or injury of the other. It usually assumes the form of either a serous or plastic uveitis, *i. e.*, an inflammation involving the iris, ciliary body and choroid. This disease, in its more serious form, is of the greatest importance, for, if not cut short in its earlier stages, it almost invariably leads to blindness.

The disease has what may be termed a prodromal stage, during which it is called *sympathetic irritation.* At this time the patient complains that the eye soon grows tired on using it. There is more or less sensitiveness to light, lachrymation and slight peri-corneal redness. The most important symptoms of this period are, a failure in the vision and a diminution in the range of accommodation. During this stage there is also apt to be found a more or less sensitive spot in the exciting eye. These symptoms of slight irritation of the eye may exist for a long period, or possibly might never lead to the dreaded sympathetic inflammation, but, as a rule, there is a gradual increase of the pain and cloudiness of the aqueous with a decrease of the visual acuity as the stage of sympathetic inflammation sets in. Sympathetic ophthalmia may also set in without any of the previous symptoms of sympathetic irritation.

Symptoms.—There is a loss of vision, due to haziness of the vitreous, which in the early stages is diffuse, but later we find large opacities floating about. Photophobia, lachrymation and ciliary neuralgia are present in varying degrees in different cases. The ciliary region is very sensitive to touch. The range of accommodation, when it can be tested, is much diminished. There may be ciliary injection, or chemosis, and the lids may be red and swollen. On examination of the eye we find the aqueous is hazy. The exudation extends into the iris and we have posterior synechiæ, which form very rapidly. The iris becomes very much swollen, a false membrane forms attaching it to the lens. There is a venous engorgement of the iris, and its entire structure becomes degenerated. The anterior chamber becomes shallow, the opacities in the vitreous increase all the time, and the choroid becomes affected. The periphery of the iris is drawn back and its pupillary edge, together with the lens, is pushed forward. Vision at last becomes entirely lost. The tension is increased during the early stages, but later becomes diminished. The field of vision becomes contracted very early in the course of the disease.

The foregoing describes a marked or severe form of sympathetic inflammation, but we may have a more mild type of the disease, which assumes a serous rather than a plastic form of inflammation. In this there will be some pericorneal injection, the iris somewhat discolored, with a few slight adhesions and the sight slightly reduced. In some cases there may be a papillitis or neuroretinitis, and in these light cases the eye may entirely recover.

Causes.—This disease of the healthy eye results from foreign bodies, injuries, or operations such as cataract extraction when occurring in the ciliary region, which have caused a partial or complete destruction of the fellow eye. From an atrophied eye, especially when accompanied by chalky or bony formations within the eye, intra-ocular hemorrhages or contusions, prolapse of the iris and anterior synechiæ, and in fact any eye that has been lost and is painful may awaken a dormant tendency to sympathetic inflammation.

The period during which there is a danger of transmission of sympathetic inflammation varies from two weeks to thirty years; the most frequent period, however, seems to be from four to eight weeks.

As to the method of transmission of the sympathetic irritation very much has been written and many experiments made, still the exact mode is far from being definitely settled. The various theories have been the conveyance of the infection by the blood-vessels; an irritation through the ciliary or optic nerves; and the more generally accepted theory of to-day of the infection spreading through the sheath of the optic nerve of one side to the chiasm and sheath of the optic nerve of the other.

Prognosis.—In the prodromal stage, or that of sympathetic irritation, the prognosis may always be considered favorable; but if later, after exudation has taken place, it is unfavorable, as in the majority of cases the disease leads to blindness.

Treatment.—Our attention should first be directed to the exciting eye, and in all eyes where we find it at all irritable, sensitive to touch and *the vision lost*, an enucleaation of that eye should *at once be made.* If the affected eye is only in the stage of prodromal irritation, the removal of the eye which is creating the sympathetic irritation will usually result in at once checking the disease. If the exciting eye contains a foreign body which cannot be independently removed, and is itself undergoing inflammatory changes, it should be removed, even though still possessing some vision, as that eye will probably be lost, and, by its removal, the other may be saved. After sympathetic inflammation has set in removal of the exciting eye will have no affect on the prognosis; hence, if it possesses vision, it should not be removed at this stage, but if no vision, it may be removed. The advisability of removing an exciting eye when it has a certain amount of vision, in a plastic form of sympathetic ophthalmia, is a decidedly delicate question, because there is a very grave probability of losing the sympathetic eye, while the eye originally causing the irritation *may* come out with the best vision.

Enucleation should always be practiced in the irritative stage, if possible, as often, if delayed, until the sympathetic eye has become actively inflamed, its removal then will not serve to check the progress of the disease. In all cases where one eye has become lost, and especially when from injuries or wounds in the ciliary region, the patient should be thoroughly cautioned as to the possibility of its serving *at any time* to cause destruction of the other eye from sympathetic ophthalmia and its removal advised. If enucleation is not submitted to at this time, they should be warned of the importance of seeking immediate advice upon the slightest sign of any pain or irritation.

Enucleation, as described, is the best operative measure for sympathetic ophthalmia.

In addition to the operative measures, when an eye is sympathetically inflamed it should be given the same treatment as that for choroiditis. The use of Atropin to dilate the pupil and relieve the pain may be tried, if there is not an exclusion of the pupil, but if there is, it had better not be used. The patient should be kept at rest in a darkened room. Hot fomentations or the cotton pad may be applied. Ice has been employed in some cases, though as a rule it is not advisable. Recently the sub-conjunctival injection of the Bichloride of Mercury has been greatly lauded by Darier and others in diseases of the uveal tract. The remedies most apt to be of value are *Bell.*, *Merc.*, *Sil.*, *Kali iod.*, *Rhus tox.* and *Bry.*

CHAPTER XV.

DISEASES OF THE CHOROID.

Anatomy.—The choroid lies between the retina and the sclera and is principally composed of blood-vessels and pigment. The choroid may be considered the nutrient membrane for the interior structure of the eyeball, and consists of four layers. The outermost layer is composed of loose connective tissue and of irregular shaped pigment cells. In separating the choroid from the sclera, these fibres are necessarily torn, and that portion remaining adherent to the choroid has been termed the lamina supra-choroidea, and that part remaining attached to the sclerotic, the lamina fusca. The next layer is that of the tunica vasculosa—a layer of large blood-vessels which forms a large portion of the parenchyma of the choroid. The third layer, known as the chorio-capillaris, is made up of the finer branches or capillaries of the arteries and veins of the tunica vasculosa. These two layers form the parenchyma of the choroid. The blood supply of the choroid is chiefly derived from the short posterior ciliary arteries, anastomosing with the long posterior and the anterior ciliary arteries. The veins, beginning as capillaries in the chorio-capillaris, take, in the tunica vasculosa, a whorl-like form and uniting into from four to six large trunks called the venæ vorticosæ, pass obliquely through the sclera at about the equatorial region of the eye and empty in the ophthalmic vein. A small amount of blood also passes out through the anterior ciliary veins. The parenchyma of the choroid contains a great many nerves coming from the short and long ciliary nerves. The most internal layer of the choroid is called the lamina vitrea or elastica. It is an elastic and perfectly transparent membrane, upon which the (uveal) pigmented epithelium lies. Nearly every pathological condition of the choroid exerts an influence upon this layer of pigment.

SEROUS CHOROIDITIS is considered by some authorities as a form of glaucoma. We usually find a serous inflammation involving the choroid, ciliary body and iris at the same time, and should more properly be termed a *serous uveitis*.

Pathology.—There is hyperemia, followed by either a serous or sero-fibrinous exudation. The increased secretion of a serous fluid within the eye may result in glaucomatous symptoms.

Symptoms.—There may be slight ciliary injection and the dotted appearance of the cornea, as in serous iritis. The aqueous and vitreous humors are slightly hazy and vision is impaired. The tension should always be examined, as it is very liable to become increased. Serous choroiditis seems often to be associated with syphilis, rheumatism or gout.

The *treatment* is the same as with other inflammations of the choroid, but the use of remedies, especially *Gels.* and *Bry.*, is very essential.

DISSEMINATED CHOROIDITIS is of the plastic form of inflammation.

Pathology. — Plastic choroiditis never attacks the whole choroid, but takes place in small patches, which may coalesce and grow larger. The hyperemia is followed by a fibro-cellular exudation into the stroma of the choroid. There is also a lymphoid infiltration along the vessels. If the process goes on, there is a proliferation of the pigment layer over the nodules, which extends deeply into the retina, and the radial fibres of the retina unite with the fibrillated structure of the nodules. In the later stages the cell elements disappear and the fibres retract, leaving a depressed retinal scar. The pigment is taken up by the cells at the periphery of the patch of exudation, and then we have the characteristic white atrophic spot surrounded by a dark pigmented border.

Symptoms.—They will simply complain that their eyes feel a little weak and that the vision does not seem quite as clear as formerly. Very fequently we find, upon ophthalmoscopic examination, extensive choroidal changes with little or no loss of the visual acuity. Often there is some night-blindness. As the disease advances toward the macula the patient may complain that objects looked at appear distorted (*metamorphopsia*). Objects may appear diminished in size (*micropsia*) or unnaturally enlarged (*macropsia*).

The most characteristic indications of choroiditis are, however, only to be determined by an ophthalmoscopic examination. In the stage of exudation, there may be seen numerous yellowish-red nodules, of a more or less circular shape, varying in size, scattered about through the equator of the eye. After a longer or shorter period the color of these plaques of exudation changes to a yellow and later to a white, or a bluish-white appearance, and, owing to the pigment proliferation around their borders, becomes surrounded by black masses of pigment. In the atrophic stage these patches become white in color—due to the showing through of the sclera—and are more or less surrounded by pigment. The choroidal vessels at the nodule are hidden in the stage of exudation, but are visible in the atrophic stage. In atrophy there is a depression or sinking of the patch, while in exudation there is an elevation. Frequently there may be even in the same eye all stages of the disease.

CENTRAL CHOROIDITIS is a form of disseminated, especially found in young persons in which the patches are larger, of a round or oval shape, and located around the optic nerve and the macula. The choroid between the patches remains healthy and while the disease is all around the macula, it is, as a rule, not involved before middle life. This form affects vision by causing a very pronounced scotoma and metamorphopsia is usually present.

SYPHILITIC CHOROIDITIS, or *Syphilitic Choroido-retinitis*, is still another form of plastic choroiditis, which occurs in the late secondary stage of syphilis. It seems to be most apt to occur in cases where syphilis has been acquired late in life, is most frequently found affecting both eyes, and is sometimes preceded by an attack of iritis.

Symptoms.—The characteristic symptom of this affection is the fine, dust-like opacities of the vitreous, seen with a weak illumination to rise like dust before the wind. The opacities may form flakes or filaments, seen floating in the characteristic dust. This dust-like haziness varies in amount from time to time. When a view of the fundus can be had we will often see a hyperemic condition of the disc, an indistinctness of its outlines and a slight haziness of the retina.

Hemeralopia, or night-blindness, is usually present when both eyes are affected. Where but one eye is affected micropsia is present in that eye. Phosphenes, generally appearing as sparkling scotoma, are seen upon entering a bright light. The vision is always very much reduced in this form of choroiditis.

Course.—This form of choroiditis may run an acute course, recovering with nearly perfect vision and leaving no trace behind. More frequently, however, there remains some impairment of vision due to the persistence of vitreous opacities, or to the changes in the choroid, which may develop gradually in the later stages of the disease.

Causes.—Choroiditis of all forms, in a very large proportion of cases, is due to syphilis, and in those cases not resulting from that disease there seems to be a decided hereditary trait. Scrofula, chlorosis, anemia and similar general disorders of nutrition may cause choroiditis. Other cases are connected with, or extend from, a progressive posterior staphyloma.

Treatment.—In acute cases general bodily rest, and in all cases complete rest of the eyes. Atropin may be useful in some cases. In the serous variety, if the intraocular tension becomes increased, Eserin should be used, and if this does not suffice an iridectomy may be made. Abstinence from all stimulants and proper hygienic measures are necessary.

Aurum.—We may have sensitiveness to light and touch, ciliary injection and some pressive pain in the eye from above downward or from without inward, aggravated on touch, or pain in the bones around the eye.

Kali iod.—It is the remedy for syphilitic choroido-retinitis characterized by great haziness and exudation into the vitreous, which may vary from day to day; also for syphilitic disseminate choroiditis, with little or no haziness of vitreous.

Mercurius.—Mercury is of great value in choroiditis, especially disseminate, and when the iris is also involved. The pains are usually intense both in and around the eye, varying to a great extent in character.

Phosphorus.—Especially when accompanied by photopsies and chromopsies of various shapes and colors (red predominating). Black spots pass before the vision. The eyes seem better in the twilight.

Bryonia.—Serous choroiditis, or inflammation of the uveal tract, following rheumatic iritis. The eyeballs feel sore to touch and motion, while darting pains through the eye into the head are usually present.

Gelsemium.—Its especial sphere of action is in serous inflammation of the uveal tract, especially if anterior to the equator, with great haziness of the humors. The impairment of vision will be great. The pain is dull, aching, pressing, in and over the eyes; may extend to occiput and be relieved by hot applications. Eyeball sore to touch. Heaviness of the lids.

Belladonna.—Acute inflammatory conditions of the choroid, particularly of the disseminate variety, and accompanied by congestive headaches. The pupil is slightly dilated, ciliary injection usually marked and the eyes sensitive to light, with full feeling as if pressed out of the head.

Prunus spin.—The characteristic indication will be found in the pain, which is usually severe, as if the eyeball were being pressed asunder, or else sharp shooting and cutting through the eye and corresponding side of the head, or crushing in character.

Nux vom., *Puls.*, *Sulph.* or *Kali mur.* may be needed.

PURULENT CHOROIDITIS (*Suppurative Choroiditis, Metastatic Choroiditis, Irido-Choroiditis, Panophthalmitis*). —All of these terms have been used by different writers to describe practically the one disease. It is, of course, possible to have a purulent inflammation of the choroid without extending to other coats of the eye, but, as a rule, the iris and ciliary body are involved and it then becomes an irido-choroiditis while frequently the purulent infiltration will extend to all the membranes of the eye and it then becomes a panophthalmitis. The characteristic feature is a purulent infiltration of the choroid and uveal tract together with the retina and vitreous which may extend to all the membranes of the eye (panophthalmitis).

Symptoms and Course.—The lids are edematously swollen, red and puffy, the conjunctiva chemosed, there is exophthalmos, with limitations in the movement of the eye. The cornea is hazy, the aqueous cloudy and hypopyon rapidly forms. There are posterior synechiæ, the anterior chamber shallow and the tension is liable to be increased. The white reflex from the fundus indicates the formation of pus within the eye. The pain in and around the eye is usually very severe and the eye is sensitive to touch. The rapid onset and course is apt to be accompanied with high fever, vomiting and other general manifestations.

Causes.—Usually from some injury of the eyeball. From operations, as the removal of cataracts or any opening of the bulbus, in cases of purulent or infectious conditions of the eye, as in dacryocystitis, perforating ulcers, etc. It is most often found in old people and the prognosis is always unfavorable.

As a *metastatic choroiditis* it may occur in two ways. First, where it is found in connection with pyemia, puerperal fever, typhoid, variola, etc., as the result of an embolus.

The second form is that found following meningitis or cerebro-spinal meningitis, and in these cases it is due to the communication between the sub-arachnoid cavity of the brain and the intervaginal space of the optic nerve. Metastatic choroiditis is apt to be very rapid and acute in its destructive course. One or both eyes may be affected, although more frequently but one.

Prognosis.—In all forms of suppurative choroiditis, from whatever cause it may arise, the prognosis is absolutely unfavorable, and when due to meningitis, pyemia, etc., life itself is of course in danger.

Treatment.—If it is due to a swollen, cataractous lens this must be extracted, or if a foreign body is found to be the cause, as is frequently the case, we must try to remove it, unless it is too deep within the eye, when it is far better to enucleate. In cases of metastatic origin little can be done, as the general illness will usually require our main attention. Enucleation should not be performed while the inflammatory process is very pronounced, on account of the danger of setting up purulent meningitis.

For the disease itself, in the first stage, ice compresses may be used with advantage, but if the pain becomes very severe in and around the eye, especially if suppuration has commenced, more benefit will be gained from warm applications, either dry or moist. Atropin may be of advantage, early, in palliating the pain.

If suppuration has advanced so far as to destroy the eye and the pain is intense, it is best to make a deep free incision of the eyeball at once and employ hot fomentations.

A nourishing diet, even stimulants, become necessary to sustain the patient's strength after suppuration has taken place.

Rhus tox.—Is useful in nearly every stage of the disease, though particularly adapted to the first. The lids are edematously swollen, spasmodically closed, and upon opening them a profuse gush of tears pours out. The conjunctiva is edematous. The iris may be swollen, pupil contracted and aqueous cloudy, while the pain in and around the eye is often severe, especially at night.

Aconite.—First stage, accompanied by high fever and much thirst. Eyelids red, swollen, hot and dry, with much pain in the eye.

Hepar.—After suppuration has begun. Eye very sensitive to touch and the pains severe and throbbing, ameliorated by warm applications.

Phytolacca.—Lids very hard, red and swollen; chemosis and pus in the interior of the eye.

Apis. — Lids edematous, chemosis, stinging pains through the eye.

Arsenicum and *Silicea* may also be indicated.

SCLERO-CHOROIDITIS ANTERIOR. — The disease is generally circumscribed to a portion of the sclera and choroid in the vicinity of the iris, although it may entirely surround the cornea. It is usually chronic in its nature, the most acute cases often lasting for months, while others will run for years. The appearance resembles very closely that described under episcleritis, although the pain is apt to be more severe and the inflammation and swelling of the conjunctival tissues is more general.

Staphyloma frequently results from a weakening of the sclera, due to the inflammation; it becomes thinned, presenting then a bluish or grayish-blue color. The staphyloma may be of varying size or shape, and occur either at the sclero-corneal margin or as far back as behind the ciliary region. This gradual bulging is a very slow process most liable to occur before adult life, and is usually unaccompanied by much pain.

SCLERO-CHOROIDITIS POSTERIOR (*Posterior Staphyloma*).—The pathological changes present in posterior staphyloma are those of an atrophic choroiditis, with a gradual thinning and atrophy of the sclera. Pigment proliferations are usually present around the edges of the crescent, especially when the condition is progressive.

Symptoms.—The disease is always found existing in myopic eyes, the eyeball is apt to appear prominent. In the progressive stage metamorphopsia is a most frequent symptom, and oftentimes complaint is made of black spots floating before the vision. An ophthalmoscopic examination will show the presence of a white crescent around the optic nerve, usually at its outer side; the size and shape of the crescent may vary greatly, from a small, narrow rim at one side to a patch several times the diameter of the optic nerve.

The optic nerve will have a pinkish appearance, from contrast with the whiteness of the staphyloma. Vision becomes affected by enlargement of the blind spot, and there is usually some amblyopia.

If the disease becomes progressive, the myopia increases, the vision is more and more impaired, the black spots before the eye increase and the optic nerve and retina become more irritable. The edges of the crescent show signs of inflammation, appear more irregular and congested; there is slight proliferation of pigment in small spots surrounding the borders of the staphyloma; the staphyloma increases more and more as the disease advances, and extends especially toward the macula. The pigment spots gradually coalesce and the centres undergo a gradual change in color until they form one large, white, atrophic spot with a narrow border of pigment surrounding it.

Myopia is especially liable to increase from ten to twenty years of age, because at this time the sclera is more pliable and the child is using the eyes more.

As a result of posterior staphyloma we frequently find opacities of the vitreous, detachment of the retina and posterior polar cataract.

Prognosis.—The prognosis should always be guarded, especially if the patient is obliged to use the eyes.

Treatment.—The proper selection of glasses for the myopia should receive our first attention, the greatest care being taken that they are not too strong. The patient should be warned against overuse of the eyes for near objects, and also to avoid stooping or bending forward at near work. The work or book should not be brought nearer as the eye becomes fatigued, but be laid aside until the eyes aré thoroughly rested. Smoked glasses may be allowed in the bright light. In aggravated cases they should be required to abstain from all near work.

The constant and continued use of Atropin for a long time is of value in some instances.

Belladonna.—Flushed face and throbbing congestive headaches. The optic nerve and whole fundus are seen congested. The eyes quite sensitive to light.

Duboisia.—Vessels of the optic disc and retina much enlarged and tortuous. Disc congested and outlines indistinct.

Phosphorus.—Fundus hyperemic. Muscæ volitantes and flashes of light before the vision. Everything looks red.

Prunus spin., *Spigelia* and *Thuja* will be of service in some cases.

ALBINISM.—General absence of pigment in the tissues is a congenital defect which may affect the entire uveal tract, and when it does the iris is of a very pale blue, the pupil is small and there is a constant effort to avoid the light. Nystagmus is usually present, the lens may be ill-developed, and there is always amblyopia. A pinkish glare is seen from the pupil, and with the ophthalmoscope the choroidal vessels are brilliantly outlined. Albinos always bring objects very close to the eyes to compensate for their amblyopia and to abate the nystagmus by strong convergence. Slight relief is obtained by the use of dark glasses to moderate the light.

TUMORS OF THE CHOROID.—*Tubercles of the choroid* occur rarely either in the disseminated form or as a single nodule.

Sarcoma.—Nearly all varieties of sarcoma may be found occurring in the choroid, although the pigmented or melano-sarcoma are by far the most frequent. Sarcomas usually commence as a rounded mass near the posterior pole of the eye, and advance toward the centre pushing the retina before it. The diagnosis of a tumor behind the detachment may present some difficulties. If a tumor *is* present, the color appears darker than in a simple detachment, the tension is increased, and the detachment has been more gradual. Glaucomatous symptoms in a detachment of the retina generally indicate the presence of a tumor. Sarcoma usually occurs in adults between the ages of forty and sixty, is primary, single and involves but one eye. Knapp divides the symptoms and progress of choroidal sarcoma into four stages: First, the origin and commencing growth without symptoms of pain or irritation of the eye, the only subjective symptom being a disturbance of vision. The ophthalmoscope at this time may show a yellowish, brown or black mass, over which retinal vessels may be seen, and behind these the vessels of the tumor itself. The first stage varies from six months to two years.

Second, the appearance of inflammatory symptoms in the eyeball. The most characteristic symptom of this stage is the severe pain due to the increased tension. In this second, or glaucomatous stage, blindness rapidly comes on and the diagnosis is now often impossible. This stage usually lasts about one year.

Third, the stage of perforation, when the external appearance of the growth, if it breaks anteriorly, is that of dark, hard nodules. There is at first relief of pain, but as the progress is now rapid, pain returns, hemorrhage and an abundant secretion sets in and there is simply a mass of tumor, and death is apt to occur from exhaustion.

The fourth and last stage is that of metastasis to other organs, usually the liver or lungs, with the inevitable death of the patient.

The prognosis is fatal if left alone and is unfavorable even in the early stage. About two-thirds of all sarcomas return after removal. The *treatment* should always be an early enucleation, and care should be taken to sever the optic nerve as far back as possible. In the third stage the orbit must be thoroughly cleaned out.

OSSIFICATION OF THE CHOROID.—True bone may, in the course of time, be formed in the choroid. It is usually found in the inner layers of atrophied balls and more especially in eyes that have been lost by irido-choroiditis.

HEMORRHAGES INTO THE CHOROID are the result of some diseased condition of the blood-vessels. The exciting cause may be from injuries, operations, coughing, etc. The hemorrhage may be slight or extensive, and it may extend forward between the choroid and retina, producing detachment of the retina, or more frequently it will extend outward between the choroid and sclera, and may cause a separation of the choroid from the sclera. The diagnosis between hemorrhage in the choroid and hemorrhage in the retina is uncertain when occurring in the outer layers of the retina; but when in the inner, or nerve-fibre, layer of the retina, the hemorrhage has a striated or flame-shaped appearance, while that in the outer layer of the retina or in the choroid is not striated. Hemorrhage into the retina usually corresponds to the retinal vessels, that is, it usually occurs along the course of the vessels and is apt to cover the vessels slightly. If there are no retinal vessels near the hemorrhage, it is more likely to be in the choroid. If the hemorrhage is in the retina, its color is more of a bright red and its outlines are well defined; while if in the choroid, it appears of a darker red and the outlines are ill-defined. Choroidal hemorrhages interfere somewhat with the vision by causing scotoma. On absorption of a hemorrhage there is left behind an atrophic spot surrounded by pigment.

Treatment.—The remedies chiefly called for will be *Arn.*, *Crotal.*, *Ham.*, *Lach.*, *Merc. corr.* or *Phosph.* See hemorrhagic retinitis.

DETACHMENT OF THE CHOROID from the sclera may occur from an injury, from an effusion of blood or serum, or from a tumor. Its diagnosis is always difficult and uncertain.

RUPTURE OF THE CHOROID.—This condition is of comparatively frequent occurrence. It is usually found after a blow on the eye. It is generally accompanied by a hemorrhage that often conceals the rupture at first. The location of the rupture is almost always at the posterior pole of the eye, and is more frequently seen between the optic nerve and the macula. It is generally vertical and in the shape of a curved line, the concavity being directed toward the optic nerve; it is most frequently a single line, with occasionally one or more bifurcations, although two distinct ruptures may occur.

The ophthalmoscopic appearances vary. In the early stage it may be completely obscured by the hemorrhage. Later it is seen as a yellowish-red line, and as the blood becomes absorbed it finally looks like a clear white line, possibly bordered by a little pigment. It causes a scotoma, more or less large, according to the size of the rupture.

Prognosis.—Should be guarded, because, in the atrophic stage, the vision may decrease after it has first improved.

COLOBOMA OF THE CHOROID.—This is a congenital anomaly, often hereditary, due to an arrest of development in fetal life and is usually associated with a coloboma of the iris. Other evidences of arrested development, such as harelip and cleft palate, are sometimes met with, together with the ocular defect. The usual location of a coloboma of the choroid is downward or downward and inward. The appearance with the ophthalmoscope is that of a white, glistening patch, with the retinal vessels seen coursing over it and occasionally masses of pigment may be found here and there upon it; the edges of the coloboma appear distinct, clear cut and often pigmented. A scotoma corresponding to the coloboma is usually present.

CHAPTER XVI.

DISEASES OF THE RETINA.

Anatomy.—The retina is the delicate membrane lying between the choroid and the vitreous and extending from the optic nerve to the ciliary processes, where it terminates in a finely indented border called the *ora serrata*. Microscopically the retina is divided into ten layers which are, from within outward: 1. The internal limiting membrane; 2. The nerve-fibre layer; 3. The layer of ganglion cells; 4. The internal molecular layer; 5. The internal granular layer; 6. The external molecular layer; 7. The external granular layer; 8. The external limiting membrane; 9. The layer of rods and cones; 10. The pigment layer.

The *internal limiting membrane* is a very thin membrane, which separates the nerve-fibre layer from the vitreous.

The *nerve-fibre layer* consists of the axis cylinders of the optic nerve-fibres.

The *layer of ganglion cells* form several layers of multipolar cells. A nerve-fibre enters each of these cells and one or more prolongations extend outward into the inner molecular layer.

The *internal molecular layer* consists of the fine fibres from the layer of ganglion cells, with an amorphous molecular substance.

The *internal granular layer* is composed of two kinds of cells with nuclei. The larger of these are nerve cells, similar to those in the layer of the ganglion cells, and having two offshoots, one passing into the inner granular layer to anastomose with the offshoots from the ganglionic cells and the other passing outward into the external molecular layer, where they anastomose with fibres from the layer of rods and cones.

The *external molecular layer* is very thin and is made up of the fibres just mentioned, together with a molecular substance.

The *external granular layer* is composed of both nerve and connective tissue elements. The former consists of bi-polar cells, from which offshoots pass outward to the layer of rods and cones and inward to the internal granular layer.

The *external limiting membrane* is the expansion formed by the terminal extremities of the fibres of Müller.

The *layer of rods and cones* is the most important part of the retina. The rods, commencing as fine fibres in the outer molecular layer, pass through the outer granular layer and, just beneath the external limiting membrane, begin to increase in size, forming the rod granule, and some distance after passing through this membrane they taper down into cylindrical shaped rods, which extend outward to the pigment layer. The cones also commence as a cone-shaped swelling in the outer molecular layer, where they are in direct communication with the fibres from the internal granular layer. The cones are shorter and thicker than the rods and are of a bottle-shaped appearance.

The *pigment layer* consists of a single layer of cells, loaded with pigment granules.

The *fibres of Müller* form the connective tissue framework of the retina.

The *macula lutea* or *yellow spot* is about 1.25 mm. in diameter and is the most sensitive portion of the whole retina. It lies to the outer side of the antero-posterior axis of the eyeball. The macula is of an oval or circular shape, of a somewhat yellowish appearance, and is best seen with a very weak illumination and by the direct method.

Anatomically the macula differs from other parts of the retina in that there are no rods, and the cones are longer and narrower than in other parts of the fundus. At the centre of the macula is a depression called the fovea centralis.

The *vascular supply of the retina* is derived from the central artery of the retina which divides on the optic disc into an upper and lower branch. Each artery is generally accompanied by a vein.

The appearance of a healthy retina is that of perfect transparency. The retinal vessels are easily distinguished from those of the choroid by being more clear and well-defined and by their taking a more radiating course and branching dichotomously.

HYPEREMIA OF THE RETINA. — In making the diagnosis the relative sizes of the arteries and veins should be considered. Normally the retinal arteries are about three-quarters the size of the corresponding vein. Hyperemia may be either active or passive. *Active hyperemia* usually results from some straining of the eyes, such as a prolonged use of the eyes at fine work or by poor light. It is very often associated with or caused by some refractive error and is, of course, present in the first stage of retinitis, or may be present with inflammation of the cornea, iris, etc. The diagnosis rests upon the congestion of the optic disc, which becomes more pinkish. It manifests itself to the patient by fatigue on using the eyes, sensitiveness to light, pain and pressure within the eye. *Passive hyperemia* results from some circulatory interference preventing the normal egress of the blood from the retinal vessels, as in glaucoma, or external to the eye, as in pressure upon the optic nerve. In this form we find the veins tortuous and increased in size, while the arteries may either remain normal or become diminished. In hyperemia the only symptoms complained of by the patient will be some dimness of vision; or of flashes of light before the eyes.

Treatment. — Hyperemia frequently depends upon some refractive error, which should be corrected by suitable glasses. Rest of the eyes is of great importance, and hence the patient should be instructed to abstain from all use of the eyes. The remedies most frequently found of service are *Dubois.*, *Bell.*, *Phos.*, *Conium.*

SIMPLE RETINITIS.—(*Serous Retinitis*, *Diffuse Retinitis*, *Edema of the Retina.*)

Pathology.—There is a hyperemia of the retinal vessels followed by an infiltration of serous fluid into all the layers of the retina. The membrane, especially in the neighborhood of the disc, becomes somewhat swollen and thickened.

Symptoms.—Patients will complain of a diminution of vision, as though looking through a mist, and the field of vision may be somewhat impaired. The ophthalmoscope will show a hyperemia of the retina and optic papilla, the outlines of which are slightly blurred and indistinct, together with diffuse grayish or bluish appearance of the retina, especially in the vicinity of the optic disc. The vessels may be slightly covered, as with a veil, or appear perfectly distinct.

Causes.—It has been attributed to exposure, to cold, heat or strong light, and as a result of over use of the eyes by poor light especially when there is some refractive error, and in many cases it is impossible to assign a distinct cause.

Prognosis.—If the disease leads to no more serious form of inflammation, recovery, with perfect restoration of vision, is the rule. Neuro-retinitis is a more common diagnosis, as the optic nerve and retina are usually inflamed at the same time.

Treatment.—*Rest* is the most important aid and the more complete it is, the better for the patients. They should be instructed to abstain from all use of the eyes, particularly by artificial light. Confinement of the patient in a darkened room is not required except in extreme cases. It is better to allow moderate exercise in the open air, taking care that the eyes are properly protected from the irritating influence of bright light by the use of either blue or smoked glasses.

Proper hygienic rules, according to the nature of the case, demand our most careful attention.

Belladonna.—The retinal vessels will be found enlarged and tortuous, particularly the veins, while a blue or blueish-gray film may seem to overspread the fundus. Extravasations of blood may be numerous or few in number. The optic disc is swollen and its outlines ill-defined. The pains are usually of an aching, dull character, though may be throbbing and severe. Phosphenes of every shape and hue, especially red, may be observed by the patient. Decided sensitiveness to light.

Duboisia.—Retinal vessels large and tortuous, especially the veins. Optic papilla swollen and outlines ill-defined. Hemorrhages in the retina. Aching in the eyes and pain through the upper part of the eyeball.

Phosphorus.—Especially with extravasations of blood. The eye may be sensitive to light and vision improved in twilight. Vision impaired, muscæ volitantes, photopsies and chromopsies are present, halo around the light.

Pulsatilla.—Hyperemia and inflammation of the optic nerve and retina accompanied by more or less severe pains in the head always relieved in the open air.

Bryonia.—Serous retinitis or hyperemia, with a bluish haze before the vision and severe sharp pain through the eye and over it. Eyes feel full and sore on motion or to touch.

Mercurius.—Retinitis with marked nocturnal aggravation and sensitiveness of the eyes to the glare of the fire.

Cactus, *Conium*, *Nux vom.*, are also remedies that may be required.

DAZZLING OF THE RETINA.—Under this heading we shall class all those cases accompanied by a dazzling sensation, due to exposure to the bright glare of the sun upon snow or water, to the electric light, etc. These conditions may produce a diffuse retinitis or neuro-retinitis. The patients complain of a dazzling, a central scotoma and slight impairment of the vision. Objects appear in a mist and the air seems to flicker. The treatment consists in the prevention of all use of the eyes and in protection from the light.

ALBUMINURIC RETINITIS.—(*Retinitis of Bright's Disease.*)

Pathology.—There is at first a slight granular exudation into the retina, with a fatty degeneration of the walls of the vessels. Following this there is a hyperplasia of the connective tissue of the retina, with subsequent fatty degeneration. Hemorrhages, which result from the degenerated walls of the retinal vessels, may occur at any place.

Symptoms.—Impairment of vision, which may vary from a slight cloudiness to complete blindness. The field of vision and also the color vision remain good. Frequently the disease is diagnosed by the ophthalmoscope before the patient is aware that there is any kidney lesion whatever. With the ophthalmoscope there is seen swelling and hyperemia of the disc; the retinal arteries are somewhat diminished and the veins increased in size; there is a diffuse haziness of the retina, together with hemorrhage and the formation of white patches.

In a well-marked case there are in the macula or its immediate vicinity numerous fine white spots, which are, in the early stages, small and separate, but later on, or in a truly typical case, form a star-shaped figure, at the centre of which lies the fovea centralis. Other of these spots and somewhat larger in size are usually seen around the papilla, and in this locality they will often coalesce into a broad zone around the optic nerve entrance, giving it the appearance usually designated as surrounded by a snow bank. These peculiar white spots of the retina are due to a fatty degeneration of the nerve-fibre and granular layers, and, when seen, may be considered almost pathognomonic of albuminuria, particularly so when assuming the star-shaped arrangement at the macula.

The white patches occur mostly in the deeper layers of the retina, as proven by the fact that the retinal vessels may usually be seen passing over them, but may be partially or completely covered by the patch at some places.

Hemorrhages are almost universally found in albuminuric retinitis. They may occur in great numbers and of various sizes and shapes, from large, dark red extravasations to small, round or linear-shaped spots scattered throughout the fundus.

Course.—When due to pregnancy, diphtheria or scarlet fever, is comparatively short, but when dependent upon the contracted kidney it is very chronic. The ophthalmoscopic picture of albuminuric retinitis may remain unaltered for a long time, the hemorrhages and white patches slowly disappearing, while new ones at the same time may make their appearance. The white plaques at the macula are always the last to disappear.

Causes.—Renal retinitis may occur with any form of kidney disease, but is especially found in the chronic interstitial nephritis, and less frequently in the chronic parenchymatous nephritis. It is also seen associated with the albuminuria of pregnancy, and more rarely with post scarlatinal nephritis. Both eyes are as a rule involved, although it may occur in but one.

Diagnosis.—The ophthalmoscopic appearances are always quite characteristic of the disease, and the presence of albumin in the urine would at once confirm the diagnosis. Diabetic and leukemic retinitis both present appearances of the fundus very similar to those found in this disease, and an examination of the urine will be necessary to clear up the diagnosis. A neuro-retinitis resulting from intra-cranial disease, especially if it be complicated by albuminuria, would present great difficulty in the differential diagnosis and a very careful study of the general symptoms would be required. The white spots in choroidal affections would differ from this by the presence of more or less pigment and by the different location and shape of the white patches. Opaque optic nerve-fibres resemble somewhat closely the snow-bank appearance around the papilla, but in opaque nerve-fibres the white patches extend out from the disc in a fan-shaped manner, it is unaccompanied by any change in the macula or edema of the retina and the vision is but little or none affected.

Prognosis.—In albuminuric retinitis the prognosis must necessarily cover two points; first, as to vision, and second, as to the life of the patient. The prognosis as to vision should always be unfavorable, excepting in the slighter cases and those occurring in pregnancy. It is extremely rare for recovery to take place in cases of kidney disease after the retina has become involved, and in the majority of cases a fatal termination will ensue inside of two years.

In the albuminuric retinitis of pregnancy the prognosis depends chiefly upon the period of gestation, and secondly upon the extent of the disease. Some cases of very extensive hemorrhages, with marked patches of infiltration of the retina and almost complete loss of vision, when only occurring in the last weeks of pregnancy, may recover, after confinement at full term, with almost complete restoration of vision. On the other hand, slight changes in the earlier months of pregnancy, may prove very serious to vision and indicate danger to the life of the patient if allowed to go on to full term. Induction of premature delivery in these cases becomes then a question of grave importance. Howe draws the conclusion that "The induction of labor is warrantable when the retinitis appears in the early stage of pregnancy and persists in spite of proper treatment, but is not warrantable in the last few weeks, in spite of the greater ease with which it is accomplished, unless the inflammation is unusually severe."

Treatment.—The principal treatment should be directed to the kidneys, the seat of the primary disease, and such hygienic and dietetic measures adopted as are recommended for Bright's disease.

Mercurius corr.—Has been more extensively used in albuminuric retinitis than any other remedy. The fatty degeneration, extravasation of blood from the weakened vessels and all the pathological changes in the eye as well as in the kidney point to *Mercurius* as the remedy.

Apis.—If associated with edematous swelling of the lids and general dropsical condition. Patient very drowsy, with little thirst and scanty urine.

Arsenicum.—If the patient is restless, especially at night after midnight, with great thirst for small quantities. Urine scanty and albuminous.

Gelsemium.—Albuminuric retinitis occurring during pregnancy. White patches and extravasation of blood in the retina. Dimness of vision appears suddenly.

DIABETIC RETINITIS (*Glycosuric Retinitis*).—The appearance and general features of this form of retinitis are practically the same as already described under albuminuric retinitis, with the exception that in diabetic retinitis there is, as a rule, less exudation or white patches and usually more hemorrhages. The white spots are apt to be smaller in size and not grouped at the macula or around the disc in the manner so characteristic of albuminuric retinitis. Retinitis occurring with diabetes is quite rare and usually makes its appearance only after the diabetes has existed for a long while.

As this form of retinitis is especially characterized by hemorrhages into the retina, compare the remedies recommended for *Hemorrhagic* and *Albuminuric Retinitis*.

LEUKEMIC RETINITIS (*Splenic Retinitis*).—An extremely rare form of retinal inflammation presenting marked swelling of the retina and disc and numerous hemorrhages. The blood-vessels are dilated and tortuous and the blood is very pale. There are white and yellow spots of exudation. Hemorrhages are especially prone to occur in this disease, they may disappear rapidly and fresh ones appear in different parts of the fundus. The diagnosis should depend upon a microscopical examination of the blood.

HEMORRHAGIC RETINITIS (*Hemorrhages into the Retina, Apoplectic Retinitis*).—Hemorrhages into the retina are common to nearly all forms of retinal inflammation, and they are also met with in cases independent of local inflammatory changes. Hemorrhages may occur in any layer of the retina, and are especially apt to occur along the course of some of the larger vessels. The immediate cause of the hemorrhage seems to be usually a disease of the walls of the vessels. If occurring in the nerve-fibre layer, as is more often the case, the hemorrhage assumes a flame-like appearance, elongated and with sharply defined borders, with radiating extremities.

If occurring deeper in the retina, the hemorrhage is more irregular or circular in shape.

Symptoms.—When the hemorrhage occurs in the posterior pole of the eye there is a positive scotoma, together with sometimes a colored vision. If at the periphery, there will be found a defect in the field of vision corresponding to the extravasation. Distortion of objects seen by the portion of the retina affected may also be present. If signs of inflammation are added to hemorrhages in the retina, we will then have a swollen appearance of the disc, its outlines are clouded and indistinct, the retina is hazy, its veins engorged and tortuous, and the arteries are small.

In the so-called *Apoplectic Retinitis* the fundus is spattered with small hemorrhages, with here and there larger, irregular patches of blood. Hemorrhagic retinitis always comes on suddenly, and chiefly among elderly people. The vessels are affected with atheroma or syphilitic degeneration, and cardiac or chronic renal disease are usually present. The occurrence of apoplexy of the retina is always indicative of serious cerebral hemorrhage.

Causes.—In the majority of cases it is due to arteriosclerosis or some heart disease, especially if but on one side; in cardiac lesions, such as hypertrophy or valvular stenosis, in embolism or thrombosis of the central vessels of the retina and in menstrual disturbances. May result from any general condition causing changes in the blood or walls of the vessels. Frequently due to traumatism.

Prognosis.—As a rule the prognosis is unfavorable, not only so far as the ocular condition is concerned, but to life as well.

Treatment.—Rest for the eyes must be enforced, and

Atropin may be used for this purpose. All undue mental or physical exertion and the use of stimulants must be strictly prohibited. Change of scene and quiet and cheerful surroundings, with suspension of business cares or literary labor, are often important. If dependent upon general disturbances, these will require our attention.

Lachesis.—From its use hemorrhages into the retina have been seen to speedily disappear and the accompanying inflammation rapidly diminished. The retina, and perhaps optic nerve, are inflamed and congested, while throughout the swollen retina may be observed extravasations of blood of various ages and sizes.

Crotalus.—In the snake poisons we possess our chief agents for hastening the absorption of extravasations of blood into the retina. *Crotalus* has been used with great advantage, especially if the hemorrhage is unaccompanied by inflammation.

Belladonna.—Apoplexy of the retina, especially when arising from or accompanied by congestive headaches. Suppressed menstruation may be the cause of the difficulty.

Mercurius corr.—Of great benefit in hemorrhages into the retina dependent upon pronounced degenerative changes in the coats of the blood-vessels, with or without inflammation.

Phosphorus, *Arnica*, *Duboisia* and *Pulsatilla* may also render valuable service.

SYPHILITIC RETINITIS.—Retinitis due to syphilitic infection may be either hereditary or acquired. In the acquired form it generally occurs with the secondary lesions, and usually both eyes are involved. It is often associated with choroiditis, and may be found with a neuritis.

Symptoms.—It is usually diffused and appears as a grayish opacity, especially around the optic disc and extending in lines as white striations along, and in places partly covering, the vessels. The vitreous is especially apt to be involved and we find a diffuse, dust-like opacity, with now and then some thin floating shreds.

Syphilitic retinitis often passes into a chorio-retinitis, when we may have the following appearances: Opacities in the vitreous, usually like a cloud of fine dust, some haziness and congestion of the retina, with numerous small, white spots throughout the fundus, sharply outlined, and with no tendency to coalesce. Patients complain of a persistent dazzling and night-blindness, with scotomas and possibly blindness following.

Course and Prognosis.—Syphilitic retinitis will often come on quite rapidly, but run an exceedingly chronic course. The prognosis should always be guarded, for, even under the most active treatment and the most favorable general conditions, the improvement may be but slight, and relapses are apt to occur. In spite of all treatment it may result in atrophic changes in the retina, choroid or optic nerve.

Treatment.—The general indications given under other varieties of retinitis should be followed.

Mercurius.—Is especially the remedy. The retina will be found hazy, congested and often complicated with choroiditis. The eye is particularly sensitive to artificial light. Nocturnal aggravation of all the symptoms. More or less pain is experienced both in and around the eye, especially during the evening and after going to bed.

Kali iod.—One of the first remedies thought of, especially if there is choroidal complication. The chief indications for its use will be furnished by the general condition of the patient.

Aurum.—After over-dosing with Iodide of Potassium or Mercury. Eye sensitive to touch, with pain in and around, seeming to be deep in the bones.

Asafetida.—When accompanied by severe boring, burning pains above the brows.

PUNCTATE RETINITIS.—Is a circumscribed form of retinitis. Its essential features consist of numerous small, white, glistening dots and striæ, closely packed together, giving a stippled appearance to that part of the fundus involved, usually in the vicinity of the macula.

PROLIFERATING RETINITIS.—A development of connective tissue in the retina, which appears as a bluish-white membranous formation, often extending into the vitreous and covering the fundus to quite an extent.

CIRCINATE RETINITIS. — Circular white patches found around the macular region, situated in the deeper layers and may be accompanied by hemorrhages.

STRIATE RETINITIS.—Grayish or yellowish streaks extending from the disc to the periphery and somewhat similar to angioid streaks of the retina.

PIGMENT DEGENERATION OF THE RETINA. — Sometimes called retinitis pigmentosa, but the disease is more of a degenerative change than it is an inflammatory condition.

Pathology.—This consists of an atrophy of the retina, with the migration of pigment into the inner layers, together with the new formation of pigment cells. The disease begins at the periphery of the fundus and gradually extends toward the posterior pole.

Symptoms. — The field of vision becomes concentrically contracted, extending as the disease advances. Hemeralopia or night blindness is usually one of the earliest symptoms and often the first to attract the patients' attention. This is due to contraction of the field which in early life is but slight and in good light the central vision is often perfect. At dusk or in feeble illumination the patient does not see well because the periphery does not react and the field is small. As years pass the field becomes contracted even in good light and finally in advanced life central vision becomes poor and gradually complete blindness follows.

Ophthalmoscopic examination will show at the entire periphery of the fundus beautifully arranged masses of pigment, which assume the shape and appearance of bone corpuscles, the processes from which extending off to unite with each other form a network which encircles the periphery of the fundus. The pigmentation will often extend farther backward along the course of the vessels. The retinal vessels become greatly contracted. The optic disc becomes of a greyish-yellow appearance.

Course.—This condition, commencing either congenitally or in early childhood, may remain stationary at some period, but usually advances steadily, with increasing contraction of the field, until finally, after middle life, vision has become nearly destroyed. Both eyes are almost invariably affected. It may be complicated with nystagmus or posterior polar cataract.

Causes.—It is undoubtedly of hereditary origin in nearly all cases and consanguinity seems to be an important factor, as intermarriage, one or two generations remote, can generally be found. Congenital deaf-mutism, epilepsy and idiocy are frequently seen in cases of retinitis pigmentosa.

Diagnosis.—It may be confounded with disseminated choroiditis, but in the latter the patches are more or less circular, are isolated and present signs of exudation with atrophy, and we find corresponding white patches with irregular pigmented borders. In retinitis there are no spots of choroidal atrophy, the pigment is stellate and is more apt to be along the vessels or covering them in spots.

Treatment.—Is of little avail. Much attention must be given to the general health for a long period. *Lyco.*, *Nux vom.* and *Phos.* are suggested as remedies.

DETACHMENT OF THE RETINA (*Amotio Retinæ*).—Separation of the retina from the choroid is usually the result of an exudation of serum, but may occur from any other exudation or hemorrhage under the retina, or from tumor.

Symptoms.—There is more or less loss of vision, which may come on suddenly. Vision is not wholly lost, unless the region of the macula is involved in the detachment. There is a limitation in the field of vision which appears to the patient as a dark cloud. If the detachment be of the lower part of the retina, the upper portion of the field of vision is lost, and, if above, the lower, and so on. Patients complain of a distortion of objects (metamorphopsia), of black spots floating before the vision and of various light sensations and phosphenes.

The ophthalmoscopic appearances are best seen by the direct method and consist of a green or bluish gray membrane which is thrown up into folds and extending forward into the vitreous. The detached retina usually oscillates on movement of the eye. The borders of the detachment are usually sharply defined and a change of focus is necessary in going from the normal to the detached retina.

The retinal vessels, as they rise over the separated portion, lose their light streak and appear dark and tortuous, oftentimes hidden, as they course up and down over the furrows of the detachment. There is generally diminished tension in all cases when not due to a tumor. The detachment usually occurs above, and extends gradually to the lower part from a sinking of the fluid. Detachments may be complete or only partial.

Course. — Detachment often develops within a few hours, but it may gradually take place during one or two weeks. Every detachment has a tendency to extend and become total and is frequently found in both eyes, but the second eye may only become involved after many years.

Causes.—It is most frequently found in very high degrees of myopia. It results from traumatism, hemorrhages, intra-ocular tumors, cysticerci and from diseased conditions of the eye, such as retinitis, cyclitis, iridocyclitis, etc.

When due to disease it probably results from a shrinking of the vitreous, which thus pulls the retina from its attachments.

Diagnosis.—As a rule is readily made. The most important point is to determine whether it is due to an intra-ocular tumor, and the most valuable sign rests on the tension, which is plus in tumor and minus in simple detachment.

Prognosis.—Is unfavorable, for the detachment, when of any size, will usually extend and become total. Treatment is sometimes followed by temporary improvement, but relapses and blindness generally occur.

Treatment.—In recent cases the patient should be confined to his bed for from four to six weeks at least, chiefly upon his back, with the eyes bandaged. In many cases the constant use of Atropin is of advantage, as it prevents accommodation and thus keeps the eye and tissue more quiet. Operations to allow the escape of the fluids have been reported with some success.

Gelsemium.—One of the most prominent remedies for serous infiltration beneath the retina dependent upon injury or myopia. Especially indicated if accompanied by choroiditis, with haziness of the vitreous and some pain.

Aurum.—Has been used successfully in some cases. "Upper half of vision as if covered by a black body; lower half visible." The choroid or retina is usually inflamed, and opacities are seen in the vitreous.

Apis.—Fluid beneath the retina. Passive pain in the lower part of the ball, with flushed face and head. Stinging pains through the eye. Edematous swelling of the lids.

Arnica, *Digitalis*, *Rhus.*

ANEMIA OF THE RETINA.—It consists in a great reduction in the size of the retinal vessels, especially the arteries, which appear as very fine threads, and, as a rule, is the only ophthalmoscopic appearance present, although the optic disc may be pale and its outlines indistinct. There is usually total blindness, and the attack may come on suddenly or gradually and last from a single moment to several weeks.

Treatment.—When the anemic condition is complete (vision entirely lost), paracentesis or iridectomy, to diminish the intra-ocular tension, may be tried. Inhalation of Nitrite of Amyl may be of service. In partial anemia associated with and dependent upon general anemia, the administration of those remedies indicated by the general condition of the patient, as *Calc.*, *China*, *Ferrum*, *Phos.*, *Puls.*, etc., should be given a trial.

EMBOLUS OF THE CENTRAL ARTERY.—An embolus may become lodged in the central artery of the retina, or in any of its branches.

Symptoms.—There is nearly always sudden loss of sight, without pain or external symptoms. Occasionally there is slight giddiness and headache, flashes of light and some uncertainty of vision preceding the sudden onset of blindness. If one of the branches is involved there may be simply a loss of the field of vision in one direction.

The optic nerve becomes paler and of a grayish-white appearance. The retinal vessels appear thin and contracted, the arteries can only be traced for a short distance into the retina, while the veins also present a contraction. Minute hemorrhages in the vicinity of the macula or disc are sometimes found. There appears within a few hours a grayish or whitish opacity of the retina, especially in the region of the macula and around the disc. This opacity gives to the fundus a pale edematous appearance, and in marked contrast to this there is a bright, cherry red spot corresponding to the position of the fovea centralis. This bright red spot is due to the red color of the choroid shining through the thinned retina. After some weeks the optic disc undergoes atrophy, the retinal opacity subsides, the arteries show a white streak and may become converted into white threads.

The diagnosis depends upon sudden blindness in one eye, the ophthalmoscopic picture already described, and the discovery of an endocarditis, valvular disease, or some other source of an embolus. Embolism may occur at any age and usually affects but one eye.

THROMBOSIS OF THE CENTRAL VEIN will present appearances very similar to those of an embolus of the artery, but with more inflammatory symptoms, simulating to some extent hemorrhagic retinitis. In complete stoppage of the vein the optic disc will be nearly obliterated by hemorrhage, there will be numerous hemorrhages throughout the retina and especially along the course of the vessels. The veins will be enlarged and tortuous and the arteries small and straight, and there may be a diffuse opacity of the retina. Thrombus usually occurs in old people with atheromata, and it also follows orbital cellulitis.

In partial plugging of the vein there will be less opacity of the retina and fewer hemorrhages. Angelucci gives the following differential diagnostic points:

"*Embolism.*—Normal course of vessels, arteries narrowed, veins gradually increasing in calibre toward the periphery, no venous pulsation, absence of retinal hemorrhages.

"*Thrombosis.*—Tortuousity of vessels, arteries of normal calibre or nearly so, veins gorged with blood and here and there interrupted, venous pulsation and retinal hemorrhages."

Causes.—Valvular disease of the heart, especially when complicated by an acute endocarditis, is the most frequent cause of embolism. It occurs also in diseases of the kidney and in aneurisms. While a thrombus generally results from a phlebitis and also in cardiac diseases.

Prognosis.—This is always unfavorable, as embolism of the central artery, when complete, almost invariably leads to blindness. When, however, a branch, instead of the main trunk, is involved, the prognosis is, of course, more favorable.

Treatment.—But little if anything of value can be done for this condition. Operations to reduce the intraocular tension and inhalations of the Nitrite of Amyl have been employed to drive the plug along into one of the smaller branches where less harm results.

HYPERESTHESIA OF THE RETINA.—Over-sensitiveness of the retina to light is an indication of retinal irritation and hyperemia. It results from uncorrected refractive and muscular errors, traumatism, nasal diseases, etc.

Symptoms.—There is dread of light, asthenopia and blepharospasm. There is frequently lachrymation and more or less neuralgic pains around the eyes and head. Upon ophthalmoscopic examination we may find slight dilatation and tortuousity of the veins of the retina.

Treatment.—Correct any refractive or muscular errors.

It may be necessary to confine the patient to a darkened room and then gradually accustom him to the light. Though usually it is better to advise *exercise in the open* *air*, with the eyes protected. Especial attention must be paid to the general health of the patient.

Belladonna.—Hyperesthesia of the retina. Eyes very sensitive to light; cannot bear it, as it produces severe aching and pain in the eye and even headache.

Conium.—Over-sensitiveness of the retina to light, especially if accompanied with asthenopic symptoms, with pain deep in the eye.

Natrum mur., *Nux vomica*, *Ignatia*, *Lactic acid*.

GLIOMA OF THE RETINA.—Is a malignant growth, consisting of small cells with a large nucleus, numerous blood-vessels and some connective tissue. It occurs in children, usually under five, and generally in but one eye.

Symptoms and Course.—The condition generally first noticed is a bright yellow reflex from the interior of the eye. There is no pain or redness and the anterior part of the eye is normal. When seen early there is noticed, with the ophthalmoscope, a white or yellowish-red tumor, with either a nodulated or smooth surface, and usually blood-vessels are seen coursing over its surface. In the second stage, the tumor increases, pain sets in, the iris and lens become pushed forward and the anterior chamber shallow. The growth continues to increase, causing distension of the eye. In the third stage the coats of the eye give way and the tumor appears externally. It becomes ulcerated, bleeds easily and exudes a bloody, fetid discharge. Its growth is rapid and soon involves the orbit and temporal regions and presents a huge vascular mass. The growth extends backward along the optic nerve to the brain, the patient becomes cachectic and death from exhaustion or brain-disease is the final result.

Diagnosis.—Purulent choroiditis so closely simulates glioma as to be spoken of sometimes as *pseudo-glioma.* The differential diagnosis depends on the history and local appearances. In choroiditis there is the history of previous illness, meningitis or cerebro-spinal meningitis, and often an inflammation of the eye will have been noticed. These two symptoms are the essential diagnostic points, although in choroiditis the mass is apt to be more yellowish in appearance and the tension minus; while in glioma the tension is rarely low and may be increased even before glaucomatous symptoms become evident. When in doubt, such eyes being always sightless, we should enucleate.

Prognosis.—In glioma the prognosis is always bad, although numerons cases are recorded where the eye has been removed early with no recurrence of the growth, but it is altogether hopeless if left to its own course.

Treatment.—Should always be by enucleation, and if made in the very early stage, there is a fair chance of eradicating the disease. In enucleation for glioma it is always best to remove as long a portion of the optic nerve as possible. If the operation is made in the glaucomatous or later stages of the disease, all the contents of the orbit should be removed. After the growth has perforated the eyeball and becomes of a fungus appearance, operation can only be considered for relief of the pain, as it is then too late to offer any hope of preserving the life.

The use of Red Clover blossoms to prevent the recurrence of glioma after operation seems to be worthy of a trial in all cases of this malignant disease. So far as we have been able to find, no other medication has ever proved of any. value.

CHAPTER XVII.

DISEASES OF THE OPTIC NERVE.

Anatomy.—The optic nerve extends from its terminal expansion, the retina, which receives visual impressions, to the brain centres, where perception takes place. It may be divided for its anatomical considerations into three separate regions—cranial, orbital and intra-ocular portions.

The optic tract formed by the union of two roots passes forward along the inferior surface of the thalamus opticus, crosses the crus cerebri and unites upon the olivary process of the sphenoid bone with the optic tract from the opposite side to form the optic chiasm or commissure.

In addition to the fibres of the optic tracts, the chiasm has fibres which appear to come from the corpus subthalamicum and serve to connect corresponding parts on opposite sides of the brain. They are known as the commissural fibres of Meynert and of Gudden, and have no direct visual function. In the optic commissure the fibres of each optic tract undergo partial decussation, the fibres of the right optic tract supplying the right half of each retina, and the left optic tract supplying the left half of each retina. The orbital portion of the optic nerve commences where it passes through the optic foramen. From the chiasm to the foramen the nerve is about 10 mm. long, and from the foramen to the eyeball it is about 28 mm. long and 4 mm. in diameter. At the optic foramen the nerve becomes invested with a sheath from the dura mater, in addition to the pial sheath in which it has been inclosed in the skull. Between the dural and pial sheaths of the optic nerve is a space which is imperfectly divided by trabeculæ of connective tissue and containing lymph. This space is directly continuous with the arachnoid cavity of the brain. The central artery and vein pierce the nerve about 15 mm. behind the eyeball. The central artery does not supply the nerve as a whole, but gives off very minute branches just behind the lamina cribrosa to supply it and the optic papilla.

The pial sheath is very closely adherent to the nerve and gives off connective tissue bands which form a network between the fibres of the nerve. The pial sheath terminates by becoming blended with the inner layers of the sclera. The dural sheath forms a fibrous covering to the nerve and terminates by blending with the outer layers of the sclera.

The ocular portion of the optic nerve is that part where it penetrates the globe. On passing into the eyeball the sheaths are left behind, as described above, and with them the connective tissue septa separating the fibres turn aside and blend with the sclera. The nerve-fibres having lost their medullary coat, are continued as naked axis cylinders, and terminate as the optic papilla. Krause estimates the number of fibres within the optic nerve as high as 400,000.

The *Lamina Cribrosa* is made up of fibrous tissue interwoven with the connective tissue sheaths and septa from the optic nerve at the level of the sclerotic opening. This structure is more or less visible with the ophthalmoscope and represents the limit of an ophthalmoscopic view.

The Ophthalmoscopic Appearance of the Healthy Papilla is that of a circular area, whitish in color, due to the lamina cribrosa, which shines through the transparent nerve-fibres—the white substance of the sheaths having terminated at this point. It generally has a pinkish tint, varying in different individuals. A little to the inner side of the disc the central artery of the retina is seen to emerge, which usually divides after passing the lamina cribrosa, although it may sometimes have divided before coming into view. The two chief divisions thus formed pass, one upward and the other downward, to the retina. The central vein is somewhat darker in color and larger in size than the artery, and accompanies it. The average diameter of the disc is about 1.6 mm., its apparent size varying with the refraction of the eye. There are frequently small lines of pigment bordering the disc at some point.

The Physiological Cup is an excavation at about the centre of the disc of a varying extent, but it never reaches to the edge of the disc, as does the cup of glaucoma. It is usually funnel-shaped and more distinctly white in appearance than is the rest of the disc.

The *Sclerotic Ring* is a whitish ring found at the edge of the disc and is caused by the opening in the choroid being somewhat larger than that in the sclera, and thus permitting the sclera to be seen through the transparent nerve-fibres. It is generally more visible at the outer edge of the disc, owing to a greater thinness of the nerve-fibres at that point.

OPAQUE NERVE-FIBRES.—This is a rather frequent congenital anomaly affecting one eye or both, and is due to the continuance of the opaque medullary sheath of some of the fibres of the nerve through the lamina cribrosa. Opaque fibres are most often seen extending either above or below, and appear as a white patch, which runs a variable distance, sometimes ending abruptly, but generally as a striated, fan-shaped margin.

COLOBOMA OF THE SHEATH OF THE OPTIC NERVE.—This is another very rare anomaly which depends upon an imperfect closure of the fetal fissure. It is often accompanied by a fissure or defect in the choroid. There is an apparent elongation downward and backward of the nerve which has a concave look.

HYPEREMIA OF THE DISC.—Simple congestion of the disc is evidenced by an increased redness, it assuming a general dull red hue which shades off into the surrounding fundus so that the outlines of the disc become blurred and indistinct. There may also be some photophobia, fatigue on using the eyes or slight pains around the eye. Occurs in all inflammations of the retina and choroid, and may be caused by refractive errors. It is also common in those exposed for a long period to the glare of a bright light. Cerebral hyperemia, fracture of the skull, or morbid process at the base of the skull may cause it.

Treatment.—See remedies under *Retinitis*.

OPTIC NEURITIS (*Papillitis*, *Choked Disc*).—Inflammation of the optic nerve has been divided clinically into several forms, viz.: *Papillitis or choked disc*, *neuritis descendens*, *neuro-retinitis*, and *retro-bulbar neuritis*. As all but the last variety present ophthalmoscopic signs and are very similar in appearances, as well as causes and pathological changes, they will be described under the general heading of optic neuritis, while to the last form, retro-bulbar neuritis, we shall devote a separate space.

Pathology.—The changes in the nerve head consist, first, of a venous hyperemia and edema, followed by a hypertrophy of the nerve-fibres, lymphoid infiltration and an increase of the connective tissue, especially that of the neuroglia of the nerve and that surrounding the central vessels. In some cases where there is less thickening of the connective tissue, gray atrophy ensues. In this the nerve-fibres are preserved, but become smaller through loss of their medullary sheath.

Symptoms.—The vision in neuritis may be perfectly normal, and yet the ophthalmoscopic picture of inflammation of the optic nerve be quite characteristic. This fact illustrates the importance of an ophthalmoscopic examination in all cases, even though central vision be perfect. Usually there is very decided impairment of vision, even to mere perception of light, which may have come on quite rapidly or more often gradually.

The field of vision is usually concentrically contracted, especially for colors. Hemianopsia, either horizontal or vertical, may be present and indicates the origin of the neuritis to be intra-cranial. There may be a central scotoma and the color sense may or may not be lost, but when it fails it is usually in the order of green first, then red and blue last.

The Ophthalmoscopic Appearances vary greatly, but in every case there is a hyperemia, haziness and swelling, or wooliness of the disc, with increase in the size of the central vein. In severe cases the swelling of the disc is so excessive that its outlines are indistinguishable, the central vein enormously distended and the artery contracted. Flame-shaped hemorrhages on or near the disc are often present and sometimes white spots of exudation are found in the retina. The retinal vessels are altered and interrupted in places. The surrounding retina is edematous and congested.

In *Papillitis*, or *Choked Disc*, we find in its simplest form a serous infiltration, causing an excessive swelling, with redness of the disc and engorgement of the retinal veins. To this may be added other inflammatory changes, resulting in a grayish exudation into the disc and surrounding retina, with sometimes hemorrhages.

Neuro-retinitis is a term frequently used in those cases where there is considerable involvement of the retina.

Neuritis Descendens is a term sometimes used in cases where the ophthamoscopic appearances, while somewhat similar to those of papillitis, are not so well marked. There is less swelling of the disc, its outlines are indistinct, the arteries small and the veins enlarged. The disc is opaque and of a deep red color and there is apt to be an infiltration along the retinal vessels. There are often more extensive changes in both the nerve and retina; they become swollen and infiltrated, hemorrhages occur and white patches appear in the retina in the vicinity of the macula and disc.

Course.—The duration of optic neuritis will vary greatly in different cases. In some the disease will reach its height in two or three weeks, remain stationary for perhaps a similar period and then subside, the nerve returning to its normal condition. Other and more severe cases may develop rapidly, but the subsidence of the neuritis will be very slow—taking weeks or months—and the symptoms are replaced by those of atrophy.

Causes.—If the neuritis is monolateral the cause is probably of local origin, depending upon some disease in the orbital region, as caries, periostitis, tumors and cellulitis; or of some disease of the surrounding structures, such as the frontal sinus or the antrum of Highmore. If bilateral, it is in the majority of instances due to some diseased condition of the brain, of which tumors (syphiloma, tubercle, glioma, and abscess) are by far the most frequent cause. Neuritis resulting from tumor of the brain is usually the most intense kind (choked disc) and does not seem to depend upon their size or location; tumors involving the cerebellum are considered the most apt to cause this lesion, while those of the convexity of the brain are least liable to cause optic neuritis. Next to cerebral tumors, tubercular meningitis is the most frequent cause. We may also find neuritis appearing in constitutional disturbances such as syphilis. It may also be found in severe febrile diseases, such as typhus, variola, etc.; in anemia, menstrual disturbances and from simple exposure to cold and rheumatism. It occurs in all ages and may be congenital.

Prognosis.—In all cases the prognosis should always be guarded, as more or less loss of vision is apt to result from atrophy of the optic nerve. If due to some grave cerebral or general disease, it is, of course, unfavorable. In neuritis from meningitis, or cerebro-spinal meningitis, useful vision may sometimes be recovered. When the neuritis is due to orbital affections, syphilis, anemia, or menstrual disturbances, the prognosis is somewhat more favorable.

Treatment.—The treatment will, as a rule, be directed to the general condition or cause of the neuritis. If resulting from some orbital condition, as cellulitis, tumors, etc., treatment as laid down under those headings would be indicated. In some cases of syphilitic neuritis the use of potassium iodide in large doses has given most flattering results. For remedies and their indications, what has been said under *Retinitis* applies to neuritis as well.

RETRO-BULBAR NEURITIS.—(*Toxic Amblyopia.*)—This consists of an inflammation of the optic nerve between the eyeball and the chiasm and partakes of the nature of both a neuritis and an atrophy.

Pathology.—The disease is one of interstitial inflammation followed by atrophy of the axial fibres of the optic nerve, with connective tissue proliferation, which may start at different points. There is an increase of nuclei, hypertrophy of the connective tissue and wasting of the nerve-fibres of a limited portion of the optic nerve known as the papillo-macular bundle. This same condition is the lesion in central amblyopia from alcoholism and other similar affections. A certain number of healthy nerve-fibres may be seen in the atrophic parts, which explains why sight may be preserved in isolated spots of the field in persons practically blind from retro-bulbar neuritis and also why they do not become perfectly blind in the amblyopia from alcohol.

This form of neuritis may be either acute or chronic in its course, and, as the causes and symptoms vary, they will be referred to separately.

Acute Retro-Bulbar Neuritis presents the following *Symptoms.*—More or less severe headache; pain in the orbit aggravated by movements of the eye and by pressure upon it; impairment of sight, which advances rapidly and may cause blindness within a day or two; central scotoma, for both color (red and green) and form, which may be partial or complete, the periphery of the field remaining normal; diminished color-perception; moderate congestion and serous effusion of the optic papilla and surrounding retina, and the termination of the condition in either a return to the normal, with recovery of vision, or a partial atrophy of the disc—always in the temporal half—with a central scotoma remaining, or a general atrophy with total blindness.

Causes.—Exposure and overwork, acute infectious diseases, such as measles, rheumatism, diphtheria, etc.; poisoning from alcohol, nicotine, lead, opium, etc., and suppression of menses.

Prognosis is always uncertain, as many cases will either partially or completely recover, while others will result in permanent blindness, with sometimes the preservation of several islets of sight in the visual field.

Chronic Retro-Bulbar Neuritis, or, as perhaps more frequently called, *Toxic Amblyopia*, *Tobacco* or *Alcoholic Amblyopia*, has the following:

Symptoms.—There is a gradual loss of vision, almost always affecting both eyes, the subjects frequently complaining of a fog before the eyes, and that they see better at dusk, or day-blindness; there is no pain, either spontaneous or upon pressure; central scotoma, at first for colors and then absolute; the color-perception is lost for both red and green; the range of accommodation is diminished; the peripheral boundaries of the visual field are normal; the ophthalmoscopic appearances in the later stages may show a slight atrophy of the temporal half, or sometimes the lower and outer quadrant of the disc.

Causes.—In a large majority of cases it is due to an abuse of alcohol, tobacco, or more frequently of both, and occurs almost exclusively in middle-aged or elderly men. When due to alcohol it is more apt to be found in those who seldom or never drink to intoxication, but who indulge in frequent drinks daily. Many other drugs, such as iodoform, the coal-tar products, arsenic, quinine, salicylic acid, etc., are also causes. The remaining cases are due to diabetes, lead, bisulphide of carbon, syphilis, multiple sclerosis, cold, menstrual disturbances, etc.

Prognosis.—In the early stage, before atrophy of the optic nerve has occurred, the prognosis may be considered favorable, as more or less complete recovery may be expected if the patients will give up their use of tobacco and alcohol. In some cases the sight will return to normal, even though triangular atrophy of the disc remains.

Treatment.—When due to alcohol or tobacco, *total abstinence from all spirituous liquors and tobacco* must be strictly enforced. The hypodermic injection of Strychnine has proven of value in some cases that would not yield to other remedies.

Nux vom. has been, and probably always will be, the most important and most commonly indicated remedy in this trouble. The results following its use are often marvelous. There are no marked eye symptoms in this disease, and therefore nothing to guide us to this drug with the exception of the cause.

Arsenic seems especially adapted to loss of vision dependent upon the use of tobacco, and has proven clinically to be of the first value in retro-bulbar neuritis.

Terebinth, *Pulsat.*

ATROPHY OF THE OPTIC NERVE.—This disease may occur in any part of the nerve, from the eye to its origin, and, when present, may extend in either direction. Atrophy may be sub-divided into non-inflammatory and inflammatory types.

Non-inflammatory (simple, primary or genuine) atrophy is that form where the wasting away of the nerve substance has not been preceded by visible signs of inflammation.

Inflammatory atrophy is that form occurring as the result of a neuritis or a retinitis.

Pathology.—Atrophy consists of changes in all the nerve elements; there is a degeneration and atrophy of the nerve-fibres; there is an increase of the connective tissue; the walls of the blood-vessels become thickened and their calibre reduced, and the whole nerve becomes smaller.

Symptoms.—The loss of central vision varies all the way from a slight depreciation to blindness. The contraction of the field of vision is first noticed for colors and then for form, and commences as a concentric, peripheric narrowing which is usually well advanced before central vision begins to decline. Contraction of the color field is usually much greater than that for form. Occasionally we find an irregular contraction of the field. Central scotoma and hemianopsia may also be occasionally found. Color blindness is always present, green or red being first affected and then blue, yellow, and white. Dilatation of the pupil is often present in complete atrophy.

The ophthalmoscopic appearances in atrophy of the optic nerve are always distinctive and characteristic.

The first change is that involving the circulation, the capillaries at the temporal side of the disc are first lost, the paleness then commences on the nasal side and then extends all over the disc.

In the non-inflammatory atrophy the disc is white, grayish, or bluish-white, with regular and sharply defined edges. The disc appears and really is smaller than normal, its excavation is shallow, saucer-shaped, and at its bottom the lamina cribrosa is distinctly seen.

The retinal vessels may appear normal, but the arteries are usually diminished in size.

Inflammatory atrophy differs from the non-inflammatory, in that the papilla is covered by connective tissue due to the previous neuritis. The neuritic atrophy gives a grayish-white color to the disc, its margins are irregular and ill-defined, its capillaries are lost and the lamina cribrosa is covered over by the organized exudate. The retinal arteries are contracted and enclosed in white lines, and the veins enlarged and tortuous. Later, the differences are less marked, the disc becomes a bluish-white, smaller in size, clear cut and the vessels contracted. In retinitic atrophy the disc is of a grayish-red color and clouded, margins indistinct and vessels greatly diminished in calibre. In inflammatory atrophy we may find in the fundus spots of atrophy and pigment indicating previous inflammation and hemorrhage, which are not seen in simple or primary atrophy.

Course.—The course is always slow, lasting for months and in many cases taking years to lead to complete blindness. Non-inflammatory atrophy generally occurs in middle life and men seem to be more subject to it than women. The atrophy of children is, as a rule, neuritic.

Causes.—Simple atrophy generally results from some disease of the spinal cord, especially locomotor ataxia, and is found in about one-third of these cases. It is also frequently found with diseases of the brain, as disseminated sclerosis, paralysis of the insane, tumors, etc. It occurs in syphilis, malaria, diabetes and some poisons. Inflammatory atrophy may follow from an inflammation of the nerve, retina, choroid, from glaucoma or embolism and from injuries of the optic nerve from penetrating wounds or fracture of the orbital walls.

Diagnosis.—In the early stages, or where there is but slight paleness of the nerve, it often requires a careful consideration of all the symptoms detailed, with especial attention paid to the field and color perception. The differential diagnosis between optic nerve atrophy and glaucoma will be considered under the latter disease.

Prognosis.—In all forms of atrophy of the nerve the prognosis should always be guarded, for, as a rule, it is unfavorable. Simple atrophy generally progresses, but in inflammatory atrophy there will at times be more or less vision preserved.

Treatment.—In true atrophy of the optic nerve very little can be done to restore vision, though we are often able to check its progress.

The general health requires most careful attention. The diet should be nutritious and light, while tobacco and all liquors must be prohibited. Mental and physical fatigue must not be allowed.

The hypodermic injection of *Strychnia* has proved efficacious in some instances.

Favorable results have been reported from the use of galvanism.

Nux vom.—Has been followed by more favorable results in this condition than any other remedy.

Argent. nit., *Arsen.*, *Verat. vir.*, and others have been used with advantage.

TUMORS OF THE OPTIC NERVE.—Very few cases of tumors of the optic nerve are on record, and those reported have been of the fibroma, sarcoma, glioma and myxoma type.

Symptoms.—There is simply a very slow, gradually increasing exophthalmos, with defective vision. The growths are usually very slow and painless, and the movements of the eyes are unaffected. There are seen upon ophthalmoscopic examination symptoms of papillitis, the veins are engorged, the papilla edematous and congested, and later there will be a shrinking of the vessels and white atrophy of the nerve.

Treatment.—Removal of the tumor is, of course, the only remedy. This should be done, if possible, without removal of the eyeball; but in most instances enucleation has been necessary. The nerve should be severed as far back as possible, so as to include the whole tumor.

CHAPTER XVIII.

AMBLYOPIA, HEMERALOPIA, COLOR BLINDNESS, AND HEMIANOPSIA.

Under this heading are classed all those conditions where there is partial or complete loss of vision without any perceptible ocular lesions. The term *Amblyopia* is applied to those cases where there is partial loss of vision which cannot be relieved by glasses, and where the eye shows no visible changes; and *Amaurosis* where the loss of vision is complete, but with no discoverable lesions of the eye.

CONGENITAL AMBLYOPIA (*Amblyopia ex Anopsia*).—Weak-sightedness from disuse results when a child with hitherto healthy eyes commences to squint, for in an effort to overcome the annoyance of seeing double he learns to suppress by a mental act the image seen by the squinting eye. As a result of this suppression, when followed for months and years, there takes place a permanent change in the nervous function of the eye, which is manifested by more or less loss of vision, *amblyopia* from non-use.

Other cases of amblyopia ex anopsia are due to non-use of the visual function, owing to congenital opacities of the cornea or lens, from persistent pupillary membrane, or in cases of strabismus in early infancy. There is usually but one eye affected in these cases, and when the vision is defective in both eyes nystagmus is often present. Often by bandaging the good eye, and thus compelling the squinting eye to perform the function of vision, even for half an hour each day, the development of amblyopia may be prevented. An existing amblyopia can sometimes be benefited by this procedure, but, as it has to be followed out for a very long time, it is apt to be neglected.

TRAUMATIC AMBLYOPIA may occur from any severe injury to the head, from concussion of the spine, or from a direct blow upon the eye.

AMBLYOPIA FROM LIGHTNING.—Cases of loss of vision from a stroke of lightning often have a greater loss of vision than can be accounted for by the recognizable changes in the eye, and hence can only be considered in part an amblyopia.

AMBLYOPIA FROM LOSS OF BLOOD.—Loss of sight may take place after severe hemorrhage and may be accompanied by changes in the retina or nerve, yet in some cases may present no visible lesions. Both eyes are usually affected, and in nearly one-half, the loss of sight is permanent.

HYSTERICAL AMBLYOPIA.—Hysterical blindness is more frequently found in young girls and women. It is usually temporary, though it may last for months or even years, and may be unaccompanied by other hysterical symptoms. The loss of vision is usually complete, and but one eye is generally affected. There may be a scotoma present. These patients will often be made to see by placing a perfectly plane glass in the form of spectacles before the eyes, and the result is due to suggestion.

There is usually a concentric contraction of the field of vision, hemianopsia and color-blindness and we have seen other functional disturbances, such as photophobia, flashes of light, ptosis, blepharospasm and strabismus, in hysterical subjects.

PRETENDED AMBLYOPIA (*Malingering*).—The pretense of blindness is not infrequently met with, and, as a rule, these subjects only claim more or less complete blindness in one eye. Simulated blindness may be practiced for various reasons, the most frequent, perhaps, being in order to secure damages after some trivial injury, to excite sympathy, to secure pensions, etc.

In all cases where the amaurosis is claimed to exist in both eyes, its detection becomes extremely difficult, and may often only be proven by careful watching of the subject without his knowledge. The action of the pupils may give some clue; if dilated and immovable, the use of a mydriatic may be suspected, for in dilatation of the pupil in true blindness there may be some contraction to the stimulus of a bright light or upon convergence, and there is apt, also, to be a shade more of dilatation when the eyes are in a shadow. By bringing an object suddenly close before the eyes in assumed blindness there may be the natural closure of the lids to prevent injury to the eye. Where the loss of sight is claimed to be in but one eye, there are several tests that may expose the deception. The test by causing diplopia is perhaps the simplest. In this a prism of eight or ten degrees is placed before the sound eye with its base up or down, and if the person on looking at a lighted candle fifteen or twenty feet away acknowledges the double images, binocular vision is at once proven. The crossed diplopia test is made by holding a prism of ten degrees base outward before the pretended blind eye, and if it really sees the eye will rotate inward for the sake of single vision. Another test is made by using a strong convex glass (12 D.) before the good eye and a plane glass before the other to read the test type at twenty feet, and if this is done he is seeing with the bad eye. Again, by paralyzing the accommodation of the good eye, or by placing a strong concave lens in front of this eye, and, if the patient can read, we know it is done with the affected eye. The stereoscope, Snelling's colored type and various other methods are also useful in discovering an assumed blindness of one eye.

In all these tests caution should be taken that the patient does not suspect that you are trying to detect his dissembling. Rather let him infer that you are seeking to find the cause of his amaurosis.

NIGHT-BLINDNESS (*Hemeralopia*).—This condition, where the sight is good by day, but more or less deficient by night or in poor illumination, may be found without any recognizable lesions of the eye and must be considered as distinct from the night-blindness occurring as a symptom of retinitis pigmentosa and other lesions of the fundus. Night-blindness is a functional complaint due to exposure to strong, brilliant lights, and is more prone to affect those whose systems have become greatly debilitated from the want of proper food. It prevails sometimes as endemic in certain countries, as in Russia, during their protracted fasts; it is frequently found in sailors, from exposure to tropical suns, and is often by them called "moon-blindness;" in soldiers, after prolonged marches; in travelers in the arctic zone, and in those who work before furnaces. Night-blindness is sometimes congenital and then remains unchanged during life.

Treatment.—A generous diet must be ordered, tonics and protection of the eyes from bright light are first required; in severe cases it may be necessary to confine the patient to a dark room with a gradual return to ordinary daylight.

Lycopodium is the remedy most commonly needed in this disorder.

SNOW-BLINDNESS.—The dazzling of the snow may produce a contraction of the visual field, scotoma and night-blindness from torpor of the retina. In other cases it will cause intense photophobia, pain, blepharospasm and result in an acute conjunctivitis, or sometimes an ulceration of the cornea.

COLOR-BLINDNESS.—Inability to discriminate colors is usually congenital, but may occur in diseases of the retina, optic nerve, brain or spinal cord, and consists of some impairment of the function of the retina. Congenital color-blindness occurs in from three to four per cent. of males, and in less than one per cent. in females. It is often hereditary, usually affects both eyes, and is incurable. There is usually a loss for but one or two of the fundamental colors (red, green and blue), and when congenital the vision in other respects may be perfect. Color-blindness causes no trouble, excepting to those in certain callings, as painters, railroad and nautical service, etc. Red is the color for which blindness is most frequently present, while the varying shades of green are next most frequently lost.

The *Young-Helmholtz* theory, was originally suggested by Thomas Young in 1807, who considered that there were three sets of color-perceiving elements in the retina, corresponding to the fundamental colors, red, green and violet, and that all other colors are mixtures of these sensations. This assumption was modified by Helmholtz, who suggests that all colors excite the red, green and violet elements at the same time, but in varying degrees of intensity. With a defect of one of these primary perceptions a color will be seen as if composed of the remaining two only. The most common defects are red-blind, green-blind or red-green blindness, and are designated according to the color which is deficient.

There are upwards of forty different tests that have been suggested for color-blindness, but the best is that made by Holmgren's wools, which consists in having the observer select from a heap of wools of various shades those that correspond to the one given him as a test object. There are three tests to be made. The first will detect all those who have any defect of color-vision, and the others show the nature of the defect.

In the first test, a skein of light pure green, rather freely mixed with white, is used and the patient required to select all the corresponding shades of green. If he selects any of the confusion colors, viz.: grays, drabs, yellows, rose and salmon, or hesitates and shows doubt as to whether he should choose one, then he should be subjected to the second test. For the second test a bright shade of purple (rose) is taken as a test; the confusion colors are blues, violets, grays and greens. If the patient be *red-blind* he will choose the *blue* and *violet*, because purple being composed of red and violet or blue, is to the red-blind identical with the two latter colors; while if he be *green-blind*, he will choose a *gray* and *bright green*. For the third test a bright red skein is selected, the confusion colors for this being the dark and light shades of green, and brown or olive. The red-blind chooses a green and dark brown; while the green-blind selects a green or lighter brown.

In *acquired color-blindness* there is impairment of the visual acuity. There may be constriction of the field both for white and colors. Acquired color-blindness is usually dependent upon some disturbance of the conducting nerve-fibres, as in neuritic atrophy or toxic amblyopia.

HEMIANOPSIA (*Hemiopia*, *Hemianopia*).—Obscuration of one-half of the visual field almost always involves both eyes. The division is almost universally vertical, although cases have been reported in which the upper or lower half of the field has been lost.

Vertical hemianopsia may be of three varieties. The most frequent form is that of *homonymous hemianopsia*, in which the corresponding half of the field of each eye is wanting. Thus the right half of the field, from the patient's point of view, is lost, and is due to a loss of function in the left half of each retina and is called right homonymous lateral hemianopsia, and is *vice versa* when the left half of the field of each eye is wanting.

This is the most common form of hemianopsia, and is due to a lesion of the visual path on the central side of the chiasm and on the same side as the blind halves of the retina. This form usually develops suddenly, often with hemiplegia, and if on the right side of the field it may be accompanied by aphasia. Homonymous lateral hemianopsia results from intra-cranial and generally cerebral disease, as tumors, hemorrhage, embolism, injuries, softening, etc.

Temporal hemianopsia (or heteronymous lateral hemianopsia) is where the external or temporal half of the field of each eye is blind. This form of hemianopsia is due to loss of conducting power in the nasal halves of the retina and results from pressure or disease at the angles of the commissure or the inner strands of the optic nerve just before reaching the chiasm and destroys all the decussating fibres of both retinæ which supply the inner or nasal halves. This form comes on less suddenly than the homonymous.

Nasal heteronymous hemianopsia is where both nasal fields are wanting and is the most rare form of vertical hemianopsia. In this the lesion attacks each side of the chiasm and destroys the non-decussating fibres.

Horizontal hemianopsia may occur in diseases of the eye or possibly from some lesion causing pressure upon the lower or upper part of the optic nerve or chiasm, or downward upon one optic tract.

Monocular hemianopsia may occur from a lesion of one optic nerve in front of the chiasm and, as a rule, has an irregular boundary line.

In a defect of the light sense where there is a corresponding defect in the form and color sense it is called absolute hemianopsia. In cases where there is defect for form, with an equal defect for colors, the light sense remaining intact, it is called relative hemianopsia. Complete hemianopsia is where there is a symmetrical absence of the entire half of the field of vision. When the hemianopsia is partial the defect is usually of an equal extent in both eyes.

The reaction of the pupil in hemianopsia is always a valuable diagnostic sign, and the examination of the pupil should be made in a dark room, the eye illuminated with a weak light, while an intense light is thrown obliquely in various directions into the pupil. According to Wernicke, if, in hemianopsia, the light thus thrown upon both the seeing and blind sides of the retina causes contraction, the lesion is back of the primary optic centres. If there is contraction when the light falls upon the seeing side of the retina and none when it falls upon the blind side, the lesion is either in or in front of the primary optic centres.

Prognosis.—Restoration of the visual field is rare, but when it does occur, it is apt to be symmetrical in both eyes. The hemianopsia is usually but one of other cerebral symptoms which may end in death. Nasal homonymous hemianopsia generally affords a better prognosis than temporal.

Treatment.—Half vision is usually only a symptom of some deep disorder of the eye, but as it is sometimes the only symptom to be found those remedies appropriate to it will be mentioned:

Upper half of visual field defective: *Aurum*, *Dig.* and *Gels.*

Right half of visual field defective: *Cyclamen*, *Lith. carb.* and *Lyco.*

Vertical hemiopia, either half invisible: *Calc. carb.*, *Chin. sulph.*, *Mur. ac.*, *Nat. mur.*, *Rhus*, *Sep.*, and *Stram.*

CHAPTER XIX.

DISEASES OF THE VITREOUS BODY.

Anatomy.—The vitreous humor is the transparent, jelly-like structure occupying the space between the lens and the retina. The vitreous has somewhat of a depression on its anterior surface called the *lenticular fossa* in which rests the crystalline lens, and to the posterior capsule of which the vitreous is attached, while behind, it is adherent to the optic nerve. The structure of the vitreous has not with certainty been determined. It is claimed that it can be split into concentric layers and various forms of cells have been found in it. Chemically the vitreous is 98 per cent. water, with salts, extractive matter and a trace of albumin. Its consistency becomes less as age advances and in adult life is slightly more tenacious than the white of an egg. Its index of refraction is identical with that of the aqueous humor. A canal of about 2 mm. in diameter runs through the vitreous from the optic nerve to the centre of the posterior capsule of the lens, and during fetal life it contains the hyaloid artery. The vitreous contains neither blood-vessels nor nerves, and yet, on account of its cells, it must be considered an organized structure.

SUPPURATIVE HYALITIS.—Purulent inflammation of the vitreous may occur when a foreign body has penetrated into it, or from an extension of some other inflammation of the eye and usually from the retina, choroid or ciliary body.

Symptoms.—There may be bulging of the pupillary border of the iris. Posterior synechiæ are usually present and the tension is diminished. Examination will show a light yellowish reflex from the fundus, and, when the pus is circumscribed, the appearance resembles very closely a glioma of the retina and is sometimes called *pseudo-glioma.* It is distinguished from the true glioma by the history, the appearance of the iris and the diminished tension. The vitreous is hazy while in glioma it is clear.

Course.—Suppuration of the vitreous usually results in destruction of the eye by extension to a general inflammation or panophthalmitis. Less severe inflammatory conditions of the vitreous result in opacities.

Treatment.—The treatment usually must be directed to the primary disease, especially choroiditis. Traumatic inflammation occurs especially from a foreign body, which usually necessitates the removal of the eye; as a rule, when pus has once formed in the vitreous the eye cannot be saved and enucleation is demanded.

VITREOUS OPACITIES.—Opacities in the vitreous may vary greatly in form and size from a mere diffuse dust-like haziness to large membranous patches or strings. They may be either fixed or floating and vary in number and color. A dust-like haziness of the vitreous suggests a syphilitic retinitis or choroiditis. Cyclitis, choroiditis, etc., are often accompanied by diffuse cloud-like opacity of the vitreous. Flakes, threads or membranous opacities result from exudation or hemorrhage. Membranous opacities may be seen adherent to the retina and result from chronic inflammation, retinitis próliferans.

Symptoms.—Impairment of vision depends upon the situation, size and density of the opacities. Patients describe the appearance as gray or black spots of different sizes and shapes and often are able to draw pictures of their appearance.

Opacities of the vitreous are best determined by an examination with the direct method at the distance of about thirty centimetres and, as the patient moves the eye upward and downward, dark spots or streaks are brought into view in the red reflex of the fundus. Vitreous opacities move in an opposite direction to the movement of the eye, while opacities of the lens or cornea move with the movement of the eye and cease as soon as the eye comes to rest. Fine opacities are best seen with a weak illumination.

Course.—Diffuse opacities may entirely clear up, or they may become aggregated into thick circumscribed shreds. The thick, circumscribed opacities may be somewhat absorbed but more slowly and obstinately.

Causes.—Opacities are especially found in myopes, with posterior staphyloma and choroidal changes. They are frequently due to some inflammation of the ciliary body, choroid or retina, or from an injury of the eye which has caused a hemorrhage into the vitreous. They have also been due to various general conditions, such as exhaustion, in anemia, menstrual disturbances, syphilis, constipation, etc.

In *muscæ volitantes* or *myodesopsia* there are no true opacities of the vitreous; the black spots complained of by patients as floating before the eye when looking at a bright surface are due to shadows upon the retina produced by some normal elements in the vitreous or from small particles of secretions or tears moving over the cornea. In these cases there is no interference with vision and the ophthalmoscope shows no opacity. They will frequently cause great annoyance, especially in nervous individuals, and are generally attributed by the laity to biliousness or indigestion.

Synchysis is a fluidity of the vitreous and can only be diagnosticated by the rapid movement of opacities in the vitreous during motions of the eye.

Synchysis Scintillans is where the fluid vitreous contains numerous scales of cholesterin and tyrosin. When seen it presents, with the ophthalmoscope, a beautiful appearance, as of a shower of brilliant crystals.

Treatment.—If there have been hemorrhages into the vitreous humor, their absorption may be hastened by *Arnica*, *Crotal.*, *Ham. virg.*, *Lach.*, *Ledum*. If the opacities are the result of inflammation of the choroid or retina, benefit has been derived from the following: *Aurum*, *Bell.*, *Gels.*, *Kali iod.*, *Kalmia*, *Lach.*, *Merc.*, *Phos.*, and *Sulph.* In syphilitic cases *Mercury* or the *Iodide of Potash* may be of service.

HEMORRHAGE INTO THE VITREOUS.—Usually occurs from the vessels of the choroid, retina or ciliary body, and generally results from an injury. The hemorrhage may be partial or entirely fill the vitreous, being so dense as to wholly obscure the red reflex of the fundus, and then may often be seen as a dark red mass by the oblique illumination. There is partial or total blindness, which may have come on gradually or suddenly. The smaller hemorrhages will often be absorbed in the course of a few weeks, but the large ones frequently leave dense membranes.

FOREIGN BODIES IN THE VITREOUS.—Usually in injury the foreign body will become lodged in the coats of the eye, although it may penetrate into the vitreous. It most generally passes in through the cornea, wounding the iris and lens, or lens alone, and more often becomes lodged either in the iris or lens. The foreign body may penetrate the sclera, in which it may be lodged, or it may drop into the vitreous, or, passing through the vitreous, become lodged in the opposite coats of the eye, or, penetrating these, may become embedded in the tissues of the orbit. A foreign body within the vitreous may become encysted, but, as a rule, it will result in inflammation, which may lead to abscess, detachment of the retina, or panophthalmitis.

The most frequent foreign bodies are chips of iron, steel, glass and shot.

Treatment.—Removal of the foreign body, if of iron or steel, by means of the electro-magnet has been successfully done in many cases. If seen before the wound is closed, the opening, if in the sclera, is somewhat enlarged, the needle of the magnet is then introduced through the wound to as near the foreign body as possible. When the substance can be located by the ophthalmoscope the needle can be passed directly to it. If, however, it cannot be seen, the appearance of the wound will often indicate the direction to be followed and a certain amount of exploratory excursions are permissible. If the penetration has been through the cornea and lens, the lens should first be removed and the needle inserted through the corneal opening. After the wound has closed, if the substance can be discerned with the ophthalmoscope, an opening may be made in the sclera by means of a meridional cut through the equatorial part of the sclera and the magnet used. Failing in the attempt to remove the foreign body, if the injury has been sufficient to destroy vision, enucleation or evisceration may be employed at once.

The inflammation arising from injuries must be subdued by ice compresses, the instillation of Atropin, and proper internal medication. The remedies will usually be *Acon.*, *Ham.*, *Led.* or *Rhus.*

CYSTICERCUS IN THE VITREOUS.—The presence of a parasite in the eye is of extremely rare occurrence in this country, but is quite frequently met with in North Germany. Its origin is between the choroid and retina. It causes detachment of the retina, and finally perforates it, enters the vitreous and sooner or later causes an irido-cyclitis, with inflammatory changes which end in destruction of the eye. It has a dumb-bell shape, is iridescent, and has a peristaltic motion. The treatment is to remove the cysticercus.

PERSISTENT HYALOID ARTERY — The hyaloid artery is an extension from the central artery of the retina which in the embryo runs from the papilla to the lens and furnishes the nourishment of the lens. Obliteration of the artery is usually complete before the termination of fetal life, but sometimes it fails and some vestige of the artery remains. With the ophthalmoscope a somewhat tortuous cord may be seen, which may extend from the disc forward to the lens or merely as a rudimentary strand attached either to the disc or lens, and in some instances it has been seen to contain blood.

DETACHMENT OF THE VITREOUS. — The vitreous may become detached from the retina by traumatism, or hemorrhages; as a result of exudation in choroiditis and from intra-ocular growths.

CHAPTER XX.

DISEASES OF THE CRYSTALLINE LENS.

Anatomy.—The crystalline lens is a transparent, biconvex, solid body that is inclosed in a transparent capsule and rests just behind the iris in a depression in the vitreous humor. The healthy lens increases in weight and volume throughout the whole of life, its diameter varies from 8.25 mm. to 10 mm. Lenses which are becoming cataractous are, as a rule, smaller than healthy lenses. The lens in the young is perfectly colorless, but becomes yellowish later in life, at the same time it becomes flatter and less elastic. The shape of the lens is, therefore, more globular in early life, and, from its greater elasticity at this period, it has a greater amplitude of accommodation.

The substance of the lens is made up of long fibres or cells and an interstitial cementing substance. The fibres are band-like structures arranged in concentric lamellæ. Each lens-fibre runs from the anterior to the posterior surface in a meridional direction, the ends meeting at the poles of the lens in such a manner as to form a stellate figure. The result of this arrangement is to divide the mass into sectors. The fibres toward the centre of the lens are more compressed than the peripheral ones, and hence the centre of the lens is spoken of as the nucleus and the more peripheral portion as the cortex. The refractive index of the lamellæ increases from the periphery toward the centre.

The capsule of the lens is a highly elastic homogeneous membrane, thicker in front than behind.

The lens is held in position by the *zonule of Zinn* or suspensory ligament of the lens, which is a continuation of the membrana limitans of the retina. This membrane is firmly attached to the ciliary processes, and, as it passes to the border of the lens, divides into two layers, to be inserted into both the anterior and posterior capsule. The small space left by the separation of this membrane is called the canal of Petit and is supposed by some to convey the nourishment to the lens.

CATARACT.—Any opacity that may occur in the lens or its capsule, or both.

Pathology.—The pathological changes in cataract have been especially studied in *senile* cataract. It commences by the separation of the lens-fibres due to sclerosis and shrinking of the nucleus with the presence of fluid within these spaces. The lens-fibres then become cloudy, swell, and finally break down.

The nucleus remains unchanged in the midst of the disintegrating cortex.

Capsular Cataract is due to a deposit upon the surface of the capsule, between it and the lens, and results from a proliferation of the capsular epithelium.

In *Soft Cataract* the fibres are swollen and varicose, they become degenerated and destroyed.

The *Traumatic Cataract* is due to a rupture in the capsule, allowing the entrance of the aqueous, which causes a swelling and disintegration of the lens-fibres.

Symptoms. — There is at first the appearance of motes before the eye and a slowly progressing dimness of vision. From the swelling of the lens, the refraction of the eye increases, so that the tendency is to cause myopia of a low degree and sometimes astigmatism. The extent of the loss of vision will depend upon the situation and extent of the opacity, being greatest when central and diffuse. The acuity of vision is gradually reduced as the cataract progresses until only perception of light remains. Photophobia and phosphenes are sometimes complained of. In ripe cataract the pupil will appear gray or white in color.

With the oblique illumination the opacity, if immature, appears as white or gray streaks or dots. The ophthalmoscope is used by the direct method, and best with a dilated pupil and a weak illumination. The most frequently seen opacities are in the form of streaks or spiculæ running from the periphery toward the centre of the lens, and which appear black upon a red field. Particles may be seen in any part of the lens, and the remainder of the lens be perfectly transparent. If the opacity involves the whole substance of the lens, there will be no reflex from the fundus.

Course.—Simple senile cataract, as a rule, follows a progressively increasing course from incipiency to full maturity; but in some cases may remain stationary for many years. The period of time required for the development of mature cataract may extend from a few months to many years. Some idea of the rapidity of the progress may be formed, as the thin, narrow striæ are of much slower course than are the broad and thick striæ. Opacities occurring as dark, flocculent masses usually advance more rapidly. Opacities showing both the striæ of the cortex and the haziness of the nucleus as well are spoken of as mixed cataracts and are usually more rapid in their progress. After reaching maturity the cataract may proceed to the condition of "over-ripeness," or Morgagnian cataract, in which the cortical substance becomes liquified and the nucleus displaced. Other changes sometimes met with in over-matured cataracts are calcareous and fatty degenerations of either the lens or its capsule.

All cataracts occurring in persons under thirty-five years of age are of the so-called soft variety, and will be referred to later.

Causes.—The strain from uncorrected refractive errors, we believe, bears a very important part in the causation of cataract.

Sugar in the urine has been found in about one per cent. of cataract cases, especially when occurring in young persons. Albumin has also been found in the urine. Cataract has been found in epilepsy and other convulsions, and after meningitis, cutaneous diseases, and in those working in excessive heat and light, as in glass-blowers. Heredity is often found in cataract. Ergot and Naphthalin have caused cataract.

Cataract is often secondary to diseases of the iris, ciliary body and choroid, and in glaucoma and detachment of the retina. Traumatism is a frequent cause.

VARIETIES OF CATARACT.—The following table, taken from De Schweinitz, gives a *résumé* of the various classifications:

Anatomically	1. Lenticular.
	2. Capsular.
	3. Capsulo-lenticular.

Clinically
- 1. Senile
  - (*a.*) Cortical
  - (*b.*) Nuclear
  - General.
- 2. Juvenile or congenital
  - (*a.*) Complete
    - Complete.
    - Congenital.
  - (*b.*) Partial
    - Lamellar, or zonular.
    - Pyramidal, or polar.
- 3. Complicated or secondary
  - Anterior polar cataract.
  - Posterior polar cataract.
  - Complete cataract.
- 4. Traumatic.
- 5. After cataract.

The clinical classifications are perhaps most frequently employed, and, as the description already given applies to the first clinical sub-division, *i. e.*, senile cataract, we will refer briefly to some of the other varieties.

COMPLETE CONGENITAL CATARACT involves all the layers of the lens and is a rare form of cataract, frequently accompanied by nystagmus. In this the lens is soft, densely opaque and either of a white or bluish-white color. There is also often an opacity of the capsule as well.

The cause of this variety of cataract has been variously attributed to heredity and disturbances of nutrition in intra-uterine life. The treatment is by discission. If, however, it has become calcareous or membranous, extraction should be made as in senile cataract.

LAMELLAR OR ZONULAR CATARACT is a congenital opacity involving only a portion of the lens, and, as its name implies, affects only one or more lamellæ between the nucleus and the cortex, forming an opaque layer surrounding the clear nucleus of the lens. In the majority of cases lamellar cataract is present in both eyes, although it does occur in but one. It is supposed that the opaque layers are the outer layers of the lens during the period when the nutrition is disturbed, later normal transparent lens substance is again deposited, forming the transparent external layers.

The vision is more or less affected, depending upon the density of the opacity and the amount of lens involved. The patients hold objects very close to the eyes and are commonly thought to be near-sighted, and true myopia may exist. With the ophthalmoscope there is seen a sharply-defined opacity in the axis of the lens which is generally circular and more or less dense; the periphery of the lens is usually perfectly clear. The darkness of the opacity is greater near the edge than the centre, and this aids in the diagnosis because a solid cataract with the nucleus involved would be densest at the centre. In addition to rickets, scrofula or hereditary syphilis is often determinable as a constitutional cause. Lamellar cataract, as a rule, remains stationary, though not invariably so.

Treatment of this form of cataract is usually by iridectomy, which should be made when, upon dilatation of the pupil, with the refractive error, if any, corrected, the vision is improved, as by displacing the pupil the transparent portion of the lens is used and clearer vision results. Discission or removal of the lens may be made when the vision is less than one-third of the normal, and when there seems no likelihood of improving the vision by an iridectomy.

ANTERIOR POLAR CATARACT (*Pyramidal Cataract*). —May be simply a minute white dot upon the capsule of the lens, or a larger, dense, chalky-white, circular patch involving both the capsule and the substance of the lens for short distance immediately beneath. It often seems to stand out in front in a pyramidal form. The condition is sometimes congenital, and, if so, usually in both eyes, and may be due to imperfect closure of the capsule, or from the remains of the pupillary membrane. More frequently it occurs after birth from a central perforating ulcer of the cornea. This form of cataract is always stationary.

POSTERIOR POLAR CATARACT is a glistening, white, round opacity of the posterior pole of the lens or its capsule. In its congenital form it is due to some remains of the hyaloid artery. When acquired it is usually the result of a disease of the choroid, vitreous or retina causing malnutrition of the lens. Opacities in the vitreous and lesions of the fundus may be present. These patients see poorly on account of the lesions further back. This form may remain stationary for a long time, but in the end the lens usually grows more opaque.

TRAUMATIC CATARACT is an opacity of the lens due to injury, and, as a rule, the whole substance of the lens becomes opaque. The traumatism may be a direct injury to the capsule of the lens, as in penetrating substances, or from rupture of the capsule from concussion due to a blow upon the eyes, and in some cases may occur without a rupture. Cataract usually forms very rapidly within a few days, after the admission of aqueous to the lens substance. Absorption may follow within a few weeks, or the swelling of the lens may cause glaucoma, iritis or cyclitis. The younger the patient the more rapid is the swelling and absorption; the danger of glaucomatous symptoms is the greater the older the patient. In an extensive rupture of the capsule some of the lens substance escapes into the anterior chamber where it swells up, breaks down and becomes absorbed.

SECONDARY CATARACT, or *after cataract*, is the term applied to changes occurring in the capsule of the lens that remains after the extraction of the cataract. This form may be either thick and opaque or thin and almost transparent. It may appear within a few days after the operation, or not for months.

Secondary cataract should never be operated upon until all signs of irritation of the eye have ceased. The longer the interval after the primary extraction before operating the better, for absorption of this secondary opacity may continue for months. The operation is that of discission.

CAPSULAR CATARACT is the name used when there is simply an opacity of the capsule. It may be congenital or secondary to some other inflammation of the eye. This form is more often placed under the heading of polar cataract.

Diagnosis.—The importance of a thorough examination of the cataract, and whether complicated or not by other diseased conditions of the eye, is of the utmost value in forming an opinion as to the advisability of an operation and the prognosis as to the ultimate vision after an extraction. The size and density of the lens, the action of the pupil, whether adhered to the capsule, sluggish or freely movable, and the tension of the eye must be considered. An inability to recognize a weak light in the different directions would at once cause a suspicion of some intra-ocular lesion. The tension of the eye should be noted, as cataract may occur with glaucoma, or with an inflammation of the ciliary body or choroid. Fluidity of the vitreous would be indicated by tremulousness of the iris and lens. The lens itself, if shriveled or flattened, or if of a chalky-white or calcareous appearance, would indicate some serious intra-ocular changes.

Operative procedures are not necessarily contra-indicated by the existence of any of these conditions, still it is important to recognize the complication in order that the probable results may be correctly appreciated by both the surgeon and the patient. In certain cases of so-called amber lenses the nucleus of the lens assumes an amber-like translucency, and there will be a reddish reflex from the fundus with the ophthalmoscope, yet the cataract is really mature as much as it ever will be. No red reflex from the fundus is to be seen with the ophthalmoscope in any other variety of cataract when matured.

Prognosis.—In the immature senile cataracts, particularly where the opacity is in the form of peripheral striæ, I believe, if they are taken in the earlier stages, that the tendency to progress to complete opacity *can* be *checked* by homeopathic treatment in the majority of cases. I believe we are warranted in holding out to patients with incipient senile cataract a probability of preserving their sight unimpaired. Rare instances of the spontaneous disappearance of cataract by absorption have been reported. The usual course, however, of cataract, when once started, is a steadily increasing opacity of the lens until complete blindness has ensued. For matured cataracts nothing but operative procedures are to be considered, and, when uncomplicated, the results are usually good. Unfavorable conditions are when the patient is very greatly debilitated, in very fat subjects, or when there is a bad cough. Catarrh of the lachrymal sac, chronic conjunctivitis and pterygium, all of which militate against the prompt healing of the wound, should be corrected, if possible, before operation is undertaken. Careful prophylaxis is always an essential feature in the prognosis and should be followed out thoroughly.

Treatment.—After years of experience in the treatment of cataract, I have no doubt that a careful selection of drugs, according to the homeopathic law, and their continuance for a long period, will succeed in a large proportion of cases in checking the progress of the disease. *But after degeneration of the lens-fibres has taken place, no remedy will be found of avail in restoring its lost transparency and improving the sight.* We must then, providing the vision is seriously impaired, resort to operative measures.

The medical treatment will consist of the selection of remedies, according to the constitutional symptoms, for the objective indications are entirely or nearly absent.

The accurate correction of all refractive and muscular errors, is in my opinion, a very important factor, which is too frequently neglected.

The following drugs have been found most efficacious in arresting the progress of cataract.

Causticum.—Of the most value of all the remedies used. The principal indications seem to be a feeling as if there was sand in the eyes, sensation of pressure in the eyes, heaviness of the lids, burning, itching of the eyes, with desire to keep them closed, photophobia, flashes of light before the eyes, winking and twitching of the lids.

Iodoform.—Seems to me especially useful in those cases of broad striæ or patches of flocculent masses in the cortex of the lens indicative of a rapidly progressing cataract.

Sepia.—Eyes feel weak, worse toward evening and better in the middle of the day; some sharp pains in the eyes, heaviness of the lids, twitching of the lids, smarting of the eyes, relieved by eating; headaches which are worse morning and evening. It is a useful remedy in the cataract of women.

Phosphorus.—Colors before vision, black floating spots before the eyes, flashes of light and the concomitant symptoms of the drug.

Calcarea phos.—Headaches, especially of the right side, pain around the right eye, aching pain in the right eye, tired feeling of the right eye.

Other remedies that may be called for are *Argent. nit.*, *Naphthalin*, *Natr. mur.*, *Nux vom.*, *Puls.*, *Senega.*

Electricity I have employed in a great many cases, but always together with remedies.

Massage of the eye in incipient cataract has been credited with surprising results by some.

Operative Treatment of Cataract.—*Iridectomy* may be performed for three purposes: First, in order to secure an artificial pupil in front of some transparent portion of the lens in central, stationary forms of cataract, as in lamellar and partial congenital cataracts. Iridectomy is indicated in these cases when, after dilatation of the pupil, there is sufficient improvement in the vision to warrant the slight disfigurement of a new pupil. It should be made in front of the clearest portion of the lens and preferably downward and inward.

As a second indication for iridectomy, it may be made for the purpose of producing artificial ripening of an immature senile cataract, according to the method suggested by Förster of bruising the lens-fibres by rubbing them.

The third use of an iridectomy is as a preliminary operation to the extraction or at the same time as the extraction. The following indications for iridectomy are recommended by Galezowski: (1) Where the iris falls before the knife; (2) in synechiæ; (3) when the corneal wound is too small; (4) in capsular cataract; (5) in subluxation of the lens; (6) in constitutional cataract (glycosuria, albuminuria); (7) in syphilis.

Discission, or needle operation, is applicable to all forms of complete cataract in children. The object of this operation is to open the capsule of the lens, and, by allowing the entrance of the aqueous to the lens substance, cause its absorption. The value of this operation is especially in children under fifteen years of age, and may be used up to the twenty-fifth year, but after that age absorption takes place very slowly, if at all. The operation may be made in congenital cataract as early as the third month, but it is just as well to wait until the child is a year old. In very early life one slight puncture is often sufficient to cause complete absorption, although in later years it will usually have to be repeated several times at intervals of two or three months. The dangers to be apprehended from discission are glaucoma from too rapid and excessive swelling of the lens substance and iritis from pressure of the swelling masses upon the iris.

The method of discission is, after dilatation with Atropin, to produce general anesthesia in young children, or the use of cocaine in older subjects. The lids, separated by the speculum, and the eye steadied by fixation forceps, the knife needle is entered through the cornea at the temporal side, and, reaching to the opposite side of the pupil, the needle penetrates the capsule, when, by using the cornea as a fulcrum, it is made to cut the capsule. More extensive cutting of the capsule may be made at subsequent operations.

After the operation Atropin should be again instilled and the eye bandaged. The patient is usually kept in bed for one day, when he is allowed to get up and the bandages removed. The pupil should be kept well dilated until absorption has ceased. In young children there is usually but very little, if any, reaction; but the older the subject the greater is the liability to swelling and inflammatory reaction. Sometimes the lens begins to rapidly swell and within a few hours fragments of the lens substance push forward into the anterior chamber, and there will be associated with it much pain and pericorneal injection. Ice compresses should be immediately applied, Atropin instilled and *Aconite* given. If not controlled within a short time and the aqueous becomes hazy, iris discolored and chemosis sets in, a large paracentesis should be made to allow of the escape of the aqueous and some of the lens substance, if possible.

Discission is also made for the opacity of the capsule following extraction. The operation is the same as just described, excepting that in secondary cataract the object is to secure by a clean cut the curling away of the divided membrane in such a manner as to give a clear pupil, and for this purpose various shaped discissions have been recommended and practiced. Care should be taken not to enter the knife any deeper into the vitreous than is necessary for a sufficient opening in the capsule.

We believe that discission should be practiced in a large majority of cases of cataract extraction, as by so doing a greater improvement of vision can be gained. The operation should never be made until all signs of irritation of the eye, after extraction, have passed away. The knife must be very sharp, and all rough handling or dragging upon the resisting bands must be avoided. Disastrous results, even panophthalmitis have resulted from discission.

Cataract Extraction.—The most favorable time for extraction is when the lens is completely opaque. As a rule, however, we operate when the cataracts have progressed in both eyes far enough to cause considerable interference with vision; selecting the eye with the poorest vision, in which the cataract is most advanced. An operation should never be performed on both eyes at one sitting.

No two operators follow precisely the same method in every detail. The procedure of one will often vary in some detail from that of another. On account of this variance, many so-called modifications are being constantly brought forward. There are, however, two essentially different methods of extraction which will be considered, viz.: Extraction with an iridectomy, and extraction without an iridectomy, or, as it is frequently called, the simple operation.

Previous to all cataract operations are certain preliminary considerations worthy of attention. Extremes of cold or heat should be avoided. Age has less influence upon success than the general condition of the patient. Any chronic disease, such as nephritis or diabetes will tend to unfavorably influence recovery from the operation. A severe cough, asthma, incontinence of urine, or any condition affecting the general health, should be controlled as far as possible. All sources of infection, such as suppurating wounds, erysipelas, catarrh of the lachrymal sac, conjunctivitis, etc., must be provided against.

Thorough antiseptic measures should be strictly followed out. The room and bedding should be perfectly clean and free from all sources of impurity; the patient should have the face, hair, beard and hands thoroughly scrubbed with soap and water once or twice before the operation. The surgeon and the assistant should have their hands scrubbed with soap and water and the nails carefully cleansed, and then again washed in a solution of Mercury or Carbolic acid. The instruments are thoroughly sterilized by boiling or cleansed either in a solution of Bichloride of Mercury, 1 to 2,000, or in Carbolic acid, 1 to 200, with the exception of the knife, which is immersed in alcohol and then for a few minutes in boiling water. The face of the patient is then washed with one of the above solutions, taking great care to cleanse the margins of the lids at the root of the cilia. The conjunctival sac, especially if it contains any secretion, should be flooded with a 1 to 4,000 solution of the Bichloride of Mercury. General anesthesia is not employed unless the patient is particularly nervous and unmanageable, when ether is administered. A four per cent. solution of cocaine is dropped upon the cornea two or three times, at intervals of about five minutes, when local anesthesia is complete.

Extraction with Iridectomy.—Anesthesia being complete, the speculum is inserted and the globe seized from below with the fixation forceps and rotated downwards. The knife is then entered by making the puncture at the corneo-scleral margin at a point on a level with a semi-dilated pupil, and is thrust carefully across and brought out directly opposite the point of entrance. Then, by a forward and backward sweep, the knife is made to cut out in the same plane parallel to the iris.

Iridectomy.—After the completion of the section the assistant steadies the eye with the fixation forceps while the iris is seized at its pupillary border with the iris forceps, gently drawn out and severed by one or two snips of the scissors. As but a small iridectomy is necessary, no undue traction should be made upon the iris.

Capsulotomy.—The cystotome is then introduced into the anterior chamber, the back of the instrument preceding and its cutting point held parallel to the surface of the lens; it is now passed beneath the iris, the point turned downward easily pierces the capsule and is gently swept around the periphery of the lens. The larger the opening in the capsule the easier is the lens removed.

Delivery of the Lens.—The final step in the operation is the removal of the lens, and for this purpose it is my preference to remove the fixation forceps and the speculum, holding the upper lid with the index finger of the left hand while the assistant draws down the lower lid; but most authorities recommend leaving the speculum *in situ.* Pressure is then made with a spoon upon the lower border of the cornea, directing the force backward, not upward, until the upper edge of the lens, having been tilted forward, engages in the wound; the direction of the force should now be slightly upward as well as backward, following the lens as it passes out. The pressure with the spoon must be diminished as soon as the equator of the lens becomes engaged in the lips of the wound.

After the lens passes through the lips of the wound a slight effort should be made to remove as much of the cortical substance as possible by gentle manipulation of the cornea with the spoon gradually coaxing it out.

Toilet of the Wound.—After removal of the lens great care should be taken to thoroughly cleanse the wound from any cortical substance, shred of capsule, or prolapse of the iris. This is done with a hard rubber spatula gently passed along or within the lips of the wound. The conjunctival sac is then thoroughly cleansed by irrigating with a solution of Boracic acid, all shreds or blood-clots removed, and the dressing is then applied. My plan has been to apply to the closed eyes a piece of sterile gauze wet in a bichloride solution, over this a thin layer of sterile absorbent cotton wet with the same solution, this shapes and moulds itself to the eyeball, and then one or two layers of dry cotton over this and held in place by two narrow strips of adhesive plaster. These plasters are to run from the cheek to the brow, one over the inner, the other the outer canthus, care being taken that there be no pressure made upon the eyeball. This dressing when carefully applied makes no pressure upon the eye, and, while light and comfortable, supports the eye by keeping the lids closed and at rest.

Accidents.—If the point of the knife catches in the wrong position in the counter-puncture it may be slightly withdrawn and entered again. If the knife has been entered with the cutting edge in the wrong direction, it is sometimes turned within the eye, but better to withdraw it and postpone the operation. If the iris falls before the knife during the incision complete the section by cutting through the iris. Another unfortunate accident is, when the incision is too small to permit of the escape of the lens; when this occurs, the incision should be enlarged with the blunt-pointed scissors. Dislocation of the lens has occurred from too great pressure with the cystotome or during the manipulation to press the lens out; it should then be removed with the scoop or wire loop.

Escape of the vitreous may occur either before or after the extraction of the lens. If it occurs before the lens has become engaged in the external wound, further pressure on the cornea must be at once abandoned, as it will cause additional loss of vitreous without resulting in the escape of the lens. The lens will then have to be removed with the scoop or wire loop, which is gently inserted well behind the lens, care being taken not to cause greater dislocation, and, by gentle pressure forward to prevent its slipping off, is gradually drawn out. When the loss of vitreous has occurred after the escape of the lens, the eye should be at once closed, a bandage applied, the patient put to bed with an ice-bag to the eye and *Aconite* given. Loss of vitreous, while a frequent and undesirable accident, is not necessarily serious, as good visual results are often obtained even after a large loss.

In some cases the division of the capsule is not of sufficient extent to allow of the shelling out of the lens, and when this occurs the cystotome must be again inserted and a larger laceration made.

Of the evil results that may occur after the operation severe pain is usually the forerunner, and may set in within a few hours or several days after a perfectly smooth operation and may indicate an intra-ocular hemorrhage, suppuration of the wound or iritis.

Intra-ocular hemorrhage is the most serious accident that occurs at the time of an extraction, and, as a rule, results in panophthalmitis and loss of the eye. It is fortunately of extremely rare occurrence.

Suppuration of the Cornea, since the general practice of antisepsis in ophthalmic surgery, has, fortunately, become of quite infrequent occurrence. It results from some infection of the wound, either introduced at the time of the operation or within the first few days following, from some lachrymal or conjunctival discharge, and in some cases occurs in the very old or debilitated patients from want of sufficient nutrition in the cornea. The onset of suppuration is usually ushered in with severe pain, and, upon examining the eye, we find the lids swollen and puffy, the conjunctiva chemosed, the cornea hazy and sloughing at the margins of the wound. The suppurative process may be checked and the wound healed without any damaging results, or it may result in slough of the cornea with leucoma, or extend into a general panophthalmitis. The treatment is practically the same as described under ulcerations of the cornea.

Iritis following cataract extraction generally makes its appearance about the eighth day, sometimes earlier or later, and should receive the usual treatment for this condition.

To prevent as well as to arrest the progress of any form of inflammation in its initial stage occurring soon after cataract extraction, no local remedy is equal to the use of ice. Internal medication is also of decided value in the treatment of the various complications. For the neuralgic pains, which often occur within the first twenty-four hours, relief can frequently be obtained from five-drop doses of the tincture of *Allium cepa*. In any inflammation of the eye following cataract extraction, *Rhus tox*. is a most valuable remedy, and is given as soon as the patient begins to complain of pain, accompanied by lachrymation and puffiness of the lids. After pus has formed, *Hepar*, *Silicea* or *Calc. hypophos.*, are of value. In some cases a low form of chronic conjunctivitis follows and one of the best things for this condition is to keep the patient out in the open air.

After-Treatment.—The patient is placed in bed in a slightly darkened room and directed to lie as quietly as possible, turning from the back to the unoperated side if he desires. We believe it best that rest in the prone position be followed for the first two or three days, when the patient may be permitted to sit up. The dressing should not be removed for the first twenty-four hours, if it has not become disarranged, or the patient has not complained of pain or discomfort of the eye. It is my custom in the simple extraction to open the eye twenty-four hours after the operation sufficiently to see if the anterior chamber is re-established and the iris in place. At the end of the second or third day, if there has been no trouble, the eye may be more thoroughly examined for the first time. In the extraction with an iridectomy the eye is not examined, unless some indication of trouble, until the second day. The covering of the unoperated eye may be removed at the end of the third or fourth day. Normally the patient will have some smarting and often pain in the eye for the first four or five hours after the operation. The application of the ice-bag to the side of the head, or raising the dressing enough to draw down the lower lid and let out a tear, will usually relieve the pain. It is now my practice to only use Atropin when indications of iritis are present. The covering of the eye, as a rule, can be removed about the sixth day and the eye protected for a few days longer with a light shield or smoked glasses.

The absence of an anterior chamber is often noticed at the first dressings, but it should occasion no alarm if the wound is clear, as it is often not restored for a number of days.

Extraction Without Iridectomy.—Simple extraction, as this is usually called, is practically the same as the operation already described, with the exception of removing a section of the iris. In perfectly successful cases it is the prettiest of all operations, because no disfigurement of the pupil, but as all authorities agree that the *safest* of all operations is that with a preliminary iridectomy, the writer has returned to that method exclusively. In this the incision varies somewhat, in that it is made wholly in the clear cornea and should involve about the upper two-fifths of its circumference. In the expulsion of the lens the pressure with the spoon should be made directly backward until the lens is tilted upon its axis and presents at the opening, when the pressure should be upward and backward, which causes an extrusion of the lens with more or less prolapse of the iris. The prolapsed portion of the iris, if it has not already returned to its place, can be made to do so by gently stroking and pushing it within the lips of the wound with a smooth probe or spatula. On replacing the iris it should return to a central position and assume its circular shape; if it should not, gentle massage through the closed lid will often cause it to do so.

After forty-eight hours a one per cent. solution of

Atropin may be instilled to prevent posterior synechiæ, which are apt to follow; in other respects, the after treatment in uncomplicated cases is the same as in extraction with iridectomy.

The accidents and complications liable to occur in this operation are the same as those already referred to, with the addition of prolapse of the iris, which may occur at the time of the operation or immediately afterward, before closure of the wound, and in some cases by the re-opening of the wound after having partially healed. When it occurs soon after the operation and cannot be returned to its place, it should be cut off. Prolapse may also occur later, and when occurring after the wound is partially healed, it should be left undisturbed, as they generally heal with a cystoid cicatrix, which in course of time flattens down.

Anterior synechia is an adhesion of the iris in the lips of the wound without being prolapsed through it. This accident causes considerable distortion of the pupil and may be the source of irritation to the eye.

APHAKIA.—Absence of the lens is recognized by greater depth of the anterior chamber; a peculiarly black pupil and often tremulousness of the iris is present. Dilatation of the pupil will often show traces of the opaque capsule left behind. The power of accommodation is also lost. Removal of the lens in an emmetropic eye will leave a high degree of hypermetropia equal to about 11 D., and, of course, much less in a previously myopic eye; in consequence, a lens of approximately this strength must be worn for distinct vision. For near vision, as reading, writing, etc., a still stronger convex lens must be used. In addition to the hypermetropia, after the extraction of the lens, there is usually a certain amount of astigmatism, varying from 1 D. to 4 D., which is more often "contrary to the rule," and which should also be corrected. Glasses, as a rule, should never be prescribed until all signs of irritation of the eye have passed away; usually best to wait one or two months after the operation.

DISLOCATION OF THE LENS.—This condition may be either partial or complete, and may be congenital (*ectopia lentis*) or from disease of the eye and from traumatism. The lens may be tilted obliquely, in the vertical plane or in any direction. It may be displaced backward into the vitreous or forward into the anterior chamber, and, from injury of the sclera, it may become lodged under the conjunctiva or entirely escape from the eye. Dislocation most often follows some disease where the vitreous has become fluid and the suspensory ligament, stretched and atrophied, gives way. High degrees of myopia favor this displacement, and when but partial, the border of the lens being in the pupil, there will exist two different states of refraction in the same eye, and we then may have monocular diplopia.

Symptoms.—A high degree of hypermetropia is produced in emmetropic eyes; the accommodation is lost, the anterior chamber is deepened from the sinking of the iris, the pupil is small, and trembling of the iris is usually present. When due to disease, atrophy of the choroid and opacities of the vitreous are generally present.

Diagnosis.—If the edge of the lens is in the pupil it will appear with the ophthalmoscope by the direct method as a dark border against the red background.

A dislocated lens will frequently become cataractous and may give rise to attacks of glaucoma, iritis, etc.

Congenital displacement usually occurs upward, upward and inward, or upward and outward. It is often hereditary and usually remains unaltered. Other defects are frequently found with congenital dislocation.

Treatment.—If the dislocated lens lies beneath the conjunctiva it is easily removed, if forward into the anterior chamber, removal by a discission in children or a peripheral incision is a very simple affair. If the lens remain clear and is but partially dislocated, it should be left alone and the most suitable glasses be prescribed. Dislocation backward into the vitreous is a much more serious affair; if of long standing and has caused no irritation of the eye, it may be left alone. If, there are signs of inflammation which may lead to destruction of the eye, its removal should be attempted.

CHAPTER XXI.

GLAUCOMA.

Glaucoma is one of the most serious of all eye diseases. It is of quite frequent occurrence and its characteristic sign is that of an increased intra-ocular tension.

Anatomy.—The important part which the iritic angle plays in the causation of glaucoma makes a knowledge of its anatomical construction important. The *iritic angle* is the point where the tissue of the iris, cellular stroma of the ciliary body, muscle of accommodation, and the posterior and external portions of the cornea and sclerotic intersect. These structures jointly form a peculiar cavernous tissue composed of flattened and rounded elastic trabecula, which, as a continuation of Descemet's membrane, forms toward the canal of Schlemm true fenestrated lamella. Into the composition of this trabecular tissue enter the elastic tendons and cellular tissue of the ciliary muscle. Toward the anterior chamber this trabecular tissue is arranged cross-wise, leaving large spaces or meshes called Fontana's spaces which communicate directly with the anterior chamber. The canal of Schlemm is a series of spaces or fissures in the sclerotic, hence the spaces of Fontana and the canal of Schlemm are nothing more than a series of continuous lacunæ communicating together. They belong to the lymphatic system and never contain blood during health. The canal of Schlemm communicates with the sclerotic veins and thus completes the connection between the anterior chamber and the venous circulation. Through the canal of Petit transfusion readily takes place from the vitreous to the aqueous humor. A system of valves is supposed to exist which prevents the blood from passing into Schlemm's canal and the anterior chamber.

PHYSIOLOGY OF SECRETION AND EXCRETION.—The normal intra-ocular pressure is equal to about 25 mm. of mercury, and the pressure in the aqueous and vitreous chambers are equal. A tension of + 3 is equal to an intra-ocular pressure of about 80 mm., but a pressure equal to 200 mm. of mercury has been produced experimentally in animals by compression of the aorta and simultaneous irritation of the fifth nerve.

The maintenance of the normal pressure in the chambers of the eye depends upon the due secretion and excretion of the fluids which traverse them. Priestley Smith has made an elaborate series of experiments regarding secretion and excretion and concludes that "the fluids which nourish the vitreous body and lens and fill the aqueous chamber are secreted chiefly by the ciliary portion of the uveal tract. The larger part of the secretion passes directly into the aqueous chamber, forward through the pupil and out at the filtration angle. A very much smaller portion passes backward through the vitreous body and escapes at the papilla. The hyaloid membrane and zonula, which separate the two chambers, are readily permeable by the vitreous fluid."

The escape of the fluids from the anterior chamber by filtration through the ligamentum pectinatum into the canal of Schlemm and sclerotic veins has been proven by the experiments of Leber.

Pathology.—In the advanced stages of glaucoma there may be found, from the long existing intra-ocular pressure, pathological changes in nearly all the structures of the eye, which only show the results of the increased tension without giving any light as to the cause of the disease. The most important changes are those found occurring at the iritic angle, and which result in a partial or total occlusion of the vessels composing or entering into the canal of Schlemm. They consist of inflammatory changes at the junction of the cornea, sclera and iris, which hinder the excretion of the fluids from the eye and in this way augment the trouble.

Symptoms.—There are certain characteristic signs or symptoms of glaucoma more or less regularly found in all varieties of the disease which may be interestingly studied individually.

Recession of the Near Point or diminution of the range of accommodation is one of the earliest prodromal symptoms. The patient gives the history of frequent changes in his near-vision glasses.

Changes in Refraction.—Glaucoma may occur in any condition of the refraction, although hypermetropia is found in from 50 to 75 per cent. of the cases. Glaucoma may also cause hypermetropia.

Iridescent Vision.—The halo or rainbow of colors around a light is perfectly circular, and the size and breadth of each colored ring increases the further the light is from the eyes. The intensity of the colors varies with the light, the red being the brightest by gas or candlelight and the blue by electric light. There is first a colorless space surrounding the light; the internal ring next to the colorless space is always the blue or bluish-green, while the outer ring is red.

The Increased Tension.—This symptom is the essential one that characterizes the disease, and is due to an increase in the contents of the eye. The degree of increased tension may vary from T+? to T+3.

Haziness of the Cornea is usually present in all forms of glaucoma, excepting the non-inflammatory, when it may be absent. The haziness is uniform, but most intense at the centre, and often shows a dull, stippled appearance of the surface. It either disappears immediately or soon after the tension becomes normal again.

Anesthesia of the Cornea is found in almost all cases of chronic glaucoma.

Dilatation and Inactivity of the Pupil.—This is a very constant symptom of glaucoma. The pupil is often oval or egg-shaped; and, in this respect, differs from the dilatation in optic nerve atrophy, when it is usually circular.

The Green Reflex from the Pupil is due to the bluish-white tinge from the haziness of the cornea and aqueous, combined with the physiological yellow tint of the nucleus of the lens caused by age.

Shallow Anterior Chamber.—This is due to a pushing forward of the lens and iris, and may be so shallow in some cases as to render an iridectomy very difficult.

The Haziness of the Humors is very slight and diffuse.

Enlargement of the Ciliary Veins is due to a damming up of the blood, which has to pass off through the anterior ciliary veins.

Pulsation of the Retinal Veins may be physiological and is found in normal eyes. It is due to a transmission of the arterial wave through the vitreous, and is apparent at the papilla because the veins bend and are contracted at this point.

Pulsation of the Retinal Arteries at the Disc.—The normal physiological pulsation of the arteries is so slight as not to be seen in normal eyes, and, when present, it is claimed by some to be almost pathognomonic of glaucoma. It is due to a resistance to the flow of blood caused by the increased intra-ocular pressure.

Pain.—This symptom varies from a slight sense of fulness or dragging to a *most severe acute neuralgia* over the whole region supplied by the fifth nerve, and may be associated with general symptoms of pallor, fever, nausea and vomiting. In acute attacks the pain may be an intense agony associated with symptoms of great depression. In sub-acute cases the pain is less marked, while in chronic cases there may simply be a sensation of fulness or discomfort.

Swelling of the Lids, Chemosis and Exophthalmos are all due to infiltration from the pressure.

Contraction of the Field of Vision is usually a loss of the inner or nasal side first, followed by a loss of the lower, then the upper part of the field. There is, however, no absolute constancy in the manner in which the field is affected, as there may be concentric contraction of the entire field, or sectional defects, and even in some cases a central scotoma with the periphery of the field remaining good. The color fields are usually contracted proportionate with the form fields.

Excavation of the Optic Disc.—More or less cupping of the disc is met with sooner or later in all forms of glaucoma, but it bears no close relation to the loss of vision. It is the result of the intra-ocular pressure, and, when complete, the vessels are pushed to the inner or nasal side; the veins are large and the arteries small, the vessels bend sharply over the edge of the disc, becoming lost to view and reappearing again at the bottom of the cup, and the disc itself appears of a grayish-blue color.

It is important to distinguish the excavation of glaucoma from that occurring physiologically and from atrophy of the nerve.

The *Physiological Cup* is white, occurs in a normally tinted nerve-head and never involves very much of the nasal part of the disc over which the vessels can be seen to course. The vessels can always be followed down the side of the cup, which is funnel-shaped and not deep like the cup of glaucoma.

The Cup in Atrophy of the Nerve is shallow and usually involves the whole of the disc. The vessels never bend sharply over its margins. The nerve-head is abnormally white from diminished capillary circulation.

The Cup of Glaucoma is abrupt and deep, the vessels disappearing at its edge. There is a crowding of the vessels to the nasal side. It often has a greenish hue, and there is usually a yellowish choroidal ring around the papilla.

The Impairment of Vision varies considerably. In every acute attack it fails rapidly and then recovers somewhat when the symptoms subside, but each attack causes a little more destruction than the preceding one, until finally it becomes completely lost.

Photopsia, or subjective sensations of light, is an inconstant symptom which may be present.

Course.—The history of a case of glaucoma will usually show a longer or shorter period of premonitory symptoms. (See acute glaucoma.) This prodromal stage may have extended over several weeks or months, and then there will occur a sudden attack of acute glaucoma, lasting from a few hours to several days, when the symptoms subside and the eye returns to normal or nearly so. These attacks return, the intervals becoming shorter and shorter, the vision more and more impaired until finally it leads to a chronic or absolute glaucoma. In some cases an acute attack may continue directly into an absolute form without any subsidence of symptoms. Glaucoma does not lead to spontaneous cure, but tends, if unchecked, to absolute blindness.

Causes.—The statistics of glaucoma show it to form about one per cent. of all eye cases. It is especially a disease of old age, some claiming that an attack of primary glaucoma under the age of thirty-five is extremely doubtful. Glaucoma simplex may occur in young people and it is also found in myopic eyes.

In some cases it seems to be hereditary. Hypermetropia predisposes to glaucoma. Neuralgia of the fifth nerve and irritation from decayed teeth may cause it. Attacks are often precipitated by hysteria, convulsions, nervous excitement, anxiety, mental disturbances, anger, fear, etc. Any condition causing vascular turgescence may cause it, as in gout, acute rheumatism, atheroma, climatric changes, intoxication, indigestion, fever, sleeplessness, etc. The use of Atropin in some eyes will cause it.

Priestley Smith concludes, from a study of the immediate causes of increased intra-ocular tension, that it may result from three conditions, viz.: "Hypersecretion by the ciliary processes, serosity of the fluids and obstruction at the filtration angle."

To an obstruction in excretion he chiefly attributes the cause of increased intra-ocular pressure. As predisposing causes to this obstruction he considers the rigidity of the sclera that increases with age, the smallness of the eye and especially the increasing size of the lens in age. He summarizes as follows:

"The causes of primary glaucoma, then, are various and complex, and are not yet completely known; but they are alike in this—they all lead to compression of the filtration-angle. With that compression the actual glaucoma process begins. The escape of fluid is retarded and the intra-ocular pressure rises; this, in its turn, increases the compression of the filtration-angle. The fluid which still exudes from the turgid ciliary body is albuminous and less diffusible than the normal secretion; it tends to accumulate behind the lens, and this latter, being pressed forward, intensifies the mischief. Thus cause and effect react upon each other in a vicious circle."

The causes of secondary glaucoma are those of some previous disease of the eye which obstructs the excretion, as annular posterior synechia, anterior synechia, dislocation and injuries of the lens, and intra-ocular tumors and hemorrhages.

Diagnosis.—The importance of an early diagnosis in this disease cannot be over-estimated, and the most usual prodromal symptoms are, a frequent changing of the reading glasses, the halos around a light and periods of obscuration of vision.

Acute glaucoma has frequently been mistaken for iritis, and in some cases the differential diagnosis, which practically rests upon the increased tension and dilatation of the pupil in glaucoma, is extremely difficult. For the differential diagnostic signs see iritis.

Glaucoma simplex and optic nerve atrophy are often mistaken for each other, the essential diagnostic point seeming to rest upon a comparison of the field of vision in the two diseases, which would, of course, be aided by the presence of any or all of the symptoms of glaucoma. We have also seen cases where the failing vision of glaucoma has been attributed to cataract. Other cases to a cold in the eye, the pain said to be neuralgic, and instillations of Atropin used. This inexcusable error could not have been made had the tension of the eye been examined.

Prognosis.—In all forms of glaucoma the prognosis is always bad, if the disease is allowed to follow its own course, as blindness inevitably results sooner or later. When, however, the proper treatment is undertaken in acute glaucoma the prognosis may be said to be favorable, doubtful in glaucoma simplex and unfavorable in the absolute or hemorrhagic glaucoma.

VARIETIES OF GLAUCOMA. — *Primary glaucoma* arises without previous disease of the eye, and *secondary glaucoma* is the result of some previous disease of the eye. Primary glaucoma may be again divided into inflammatory, either acute or chronic, and the non-inflammatory usually spoken of as simple. The terms hemorrhagic and absolute are also used to describe a certain type or stage of glaucoma.

ACUTE GLAUCOMA.—Usually the patient has had warning of impending danger in the way of certain *premonitory symptoms*—due to an increased tension and not to inflammation. There is impairment of the accommodation, where the patient keeps changing his glasses every little while for stronger and stronger ones. He complains of a periodic dimness of vision, and of a rainbow of colors encircling a light, and, upon examination of the eye at this time, there will be detected a slight increase of the tension; the cornea is a little dull and diffusely clouded, the pupil is dilated and sluggish, the field of vision may be contracted and there may be a hyperemia of the retina. Such an attack lasts a few hours, when the eye returns to normal, and may remain so for weeks or months, when another similar attack occurs. These infrequent attacks may occur for years, the eye gradually undergoing changes so that it is not normal between attacks; and in this way gradually pass into a chronic glaucoma. As a rule, however, the attacks become more and more frequent, when suddenly there comes on an attack of acute glaucoma. The onset is apt to occur during the night and sets in with severe pain in the eye and head, which increases in severity and is accompanied by rapid loss of vision and often by vomiting, fever and general prostration. These attacks are usually brought on by some sudden excitement or grief, or some venous congestion as from a feeble heart. Upon examination of the eyes we may find any or all of the following symptoms: The lids may be swollen and edematous, conjunctiva inflamed, scleral vessels injected, lachrymation, photophobia, cornea hazy and may have lost its sensitiveness to touch, iris discolored, pupils dilated and sluggish, greenish reflex from the pupils, aqueous cloudy and anterior chamber shallow. There is *intense* pain in the eye and head, *the eyeball is hard*, the vision is impaired and the field contracted. Ophthalmoscopic examination, if possible, will show an excavation of the optic disc, the retinal arteries small and pulsate, the retinal veins enlarged.

An attack of acute glaucoma may last from a few hours to several days or weeks, when the symptoms gradually subside and the vision improves. These attacks usually follow one another, the intervals growing less and less, until it finally passes into what is called chronic or absolute glaucoma. In rare cases the first attack will be of unusual severity, in which the vision does not return, the tension does not decrease and the dulness of the cornea persists. These cases are called *glaucoma fulminans.* The cupping of the optic nerve is frequently not present in an attack of acute glaucoma. The impairment of the vision may mean that it is reduced to the faintest glimmer of light. The pain in acute glaucoma is often so intense that the patient may ignore a complete loss of vision and demand relief for his neuralgia, and in this way often mislead the physician.

CHRONIC GLAUCOMA.—This form may develop from an acute attack, but generally develops gradually directly from the premonitory stages, the symptoms of the acute, irritation being absent.

Its symptoms are those of acute glaucoma, but less intense, we find the anterior ciliary veins enlarged and tortuous, the sclerotic has a dull, leaden hue, the cornea is hazy and loses its sensitiveness to touch, the pupil is large and inactive, the iris is discolored and atrophied, the anterior chamber is shallow, the tension is increased, may be + 3. An ophthalmoscopic examination shows an excavation of the optic disc, the retinal veins large and the arteries small and pulsate. There is a progressive failure of sight, the field becomes more and more contracted and the halo around the light is seen. The pain in chronic glaucoma varies, though, as a rule, is not so violent and may be entirely absent. Chronic glaucoma gradually leads on to absolute.

NON-INFLAMMATORY GLAUCOMA (*Simple Glaucoma*).—In this form there are no inflammatory attacks, pain, or marked external symptoms; simply an increased tension which varies at different times and is usually less than in other forms. The pupil is dilated and sluggish, the vision is impaired and the field contracted. With the ophthalmoscope there is seen an excavation of the optic disc, some choroidal atrophy around the disc and displacement of the retinal vessels. The characteristic signs of non-inflammatory glaucoma are the increased tension, excavation of the disc and a progressive contraction of the field of vision, especially on the nasal side. The central vision often remains good until the field has become almost lost. The absence of pain and inflammation together with the very gradual loss of vision renders the patient often unconscious of any trouble until late. Simple glaucoma runs a very chronic and insidious course, lasting for years and if unchecked leading to blindness. It may terminate in any form of inflammatory glaucoma.

HEMORRHAGIC GLAUCOMA. — Differs from other varieties by the addition of hemorrhages into the retina. The symptoms are the same, plus the greater tendency to hemorrhage. The hemorrhage occurs especially from the retinal vessels. Sudden relaxation of the tension by an iridectomy has often resulted in a serious intra-ocular hemorrhage, causing destruction of the eye. The pain in this form of glaucoma is often unbearable and frequently necessitates enucleation. In many cases the hemorrhage is the cause of the outbreak of acute symptoms.

ABSOLUTE GLAUCOMA.—By this we mean a glaucoma that has run its course, or all cases that have resulted in a total loss of sight. When the result of acute or chronic glaucoma, the anterior ciliary veins are large and dark, the conjunctiva is thinned, the sclera pale, the cornea rough, hazy and not sensitive to touch; the pupil is dilated to a mere rim, the lens is cataractous, the pain often continues severe and the patient complains of photopsies and chromopsies.

If resulting from simple glaucoma the eyeball will usually appear healthy and may be free from pain, but there is extreme hardness of the ball, excavation of the disc, choroidal atrophy around the disc, arteries contracted, anterior chamber shallow, pupil dilated and vision entirely lost. An eye may remain in this condition for years or pass into degenerative changes at any time.

SECONDARY GLAUCOMA.—Is where we find increased tension with other glaucomatous symptoms in eyes showing other diseased conditions. The most frequent causes of secondary glaucoma are total adhesions of the iris. Ulcers or wounds of the cornea with prolapse of the iris and staphylomata. Injuries, operations upon, and luxations of, the lens. Atheroma of the retinal vessels and tumors of the interior of the eye may cause.

Treatment.—In the premonitory stage where the patient suffers from only occasional attacks of temporary blindness, pain, etc., we may look for benefit from the use of remedies. Local treatment consists in the use of the myotics—Eserin and Pilocarpin. Eserin may be employed in the strength of from one-half to two grains to the ounce of water and may be instilled into the eye as often as every hour, and should in itself speedily cut short an attack. Pilocarpin in twice the strength of Eserin is preferred by some. Even in some cases of acute glaucoma, if used early and often, the necessity of an operation may be postponed, if not permanently avoided. In all cases the use of Eserin should be early, *very early*, hence we believe it best in cases once having had a premonitory attack, that the patient should be supplied with the Eserin with directions as to its use that no time should be lost. The action of the Eserin is to cause contraction of the pupil and in this way the iris is drawn away from the iritic angle and the filtration passages opened ; it also, by constriction of the vascular system of the eye, diminishes secretion. Mydriatics, especially Atropin, must always be avoided, as they serve to increase the tension and may even cause an acute attack of glaucoma.

The correction of all refractive errors, thus relieving the strain upon the accommodation and through this choroidal congestion, is of great importance.

Iridectomy is *the* operation for this disease, and it has been the means of saving useful vision in thousands of patients who would otherwise have been hopelessly blind. While iridectomy is the most valuable remedial agency extant for this disease, still it is not infallible, as in some cases or forms of glaucoma even this operation will not check the disease. The operation is preferably made early, before the vision has been too long affected. In acute glaucoma we can expect to retain the vision where it is at the time of operation, and if not too long standing we usually get more or less improvement in the sight. Iridectomy may also be made to relieve the pain even after the vision is totally and permanently destroyed. It sometimes happens where the first iridectomy has not relieved, that the second or even the third iridectomy or repeated sclerotomies will do so. In acute inflammatory glaucoma an iridectomy is, as a rule, extremely favorable. In operating, the previous use of Eserin is advisable, as it renders less liable accidents from sudden relief of the tension, and it should also be used in the sound eye as well, for the mental anxiety caused from the dread of an operation has not infrequently been the cause of an attack in the good eye. Ether should, as a rule, be used, as thorough anesthesia cannot be obtained from cocaine in a glaucomatous eye. The incision should be made entirely in the sclera, the iridectomy large and care taken not to injure the capsule of the lens, which is liable to occur owing to the shallow anterior chamber, and that the escape of the aqueous be very gradual. The results of an iridectomy in non-inflammatory glaucoma are quite problematical and very far from satisfactory, the best authorities of to-day agreeing that considerably over fifty per cent. will continue to progress after the operation and some very rapidly going on to blindness. It has been my custom in recent years to advise against operation in simple glaucoma until after all other treatment has failed to check the disease.

Sclerotomy has been strongly advocated by De Wecker, but it has not seemed to have met with the hearty support of the other authorities. In certain cases, especially the hemorrhagic form of glaucoma, sclerotomy may with advantage take the place of iridectomy. Sclerotomy is often only resorted to after an iridectomy has failed to give relief.

In the treatment of glaucoma, especially in the premonitory stage, the habits of our patient should receive careful attention. The excessive use of stimulants or any exhaustive mental or physical labor must be strictly forbidden. Only moderate use of the eyes should be allowed, and, during the attacks, complete rest is necessary. Bright light should be avoided, or the eyes protected by colored glasses. The diet should be good and nutritious.

Massage has been of service in the treatment of simple glaucoma, but its effect is not lasting and therefore should be frequently repeated.

The results from internal remedies alone in glaucoma seem to me somewhat problematical. In the majority of cases recorded, where no operation was made, the local use of Eserin was employed as well as the remedy, and in consequence it is impossible to say what effect the remedy had.

Gelsemium.—Is one of the principal remedies in this disease. Its use has depended upon the fact that clinically it has proven its value.

Bryonia.—From its value in serous inflammations in general. The eyes feel sore to touch and on moving them. There may be a halo around the light, with sharp, shooting pains through the eye and head.

Osmium.—This remedy has proven of value in the hands of some. It has sudden, sharp, severe pains in and around the eye. Dimness of vision, objects seem in a fog. Halo of various colors around a light.

Belladonna.—The pains are usually severe and throbbing. The eyes are hot and dry, with sensitiveness to light. Halo around the light, red predominating.

Phosphorus, *Asafetida*, *Cedron*, *Colocynth*, *Prunus spin.* and *Spigelia* have all proven of great service in individual cases.

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